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COMING SOON

Operating characteristics and technical advantages of emulsifiable solvent cleaning.

A practical, simple and accurate method of plating on lead alloys, pewter and Britannia.

Results obtained with electroless barrel nickel plating in commercial production.

How an aqueous solution of platinic chloride may be applied to porcelain and ceramics to obtain a conducting coating of pure platinum.

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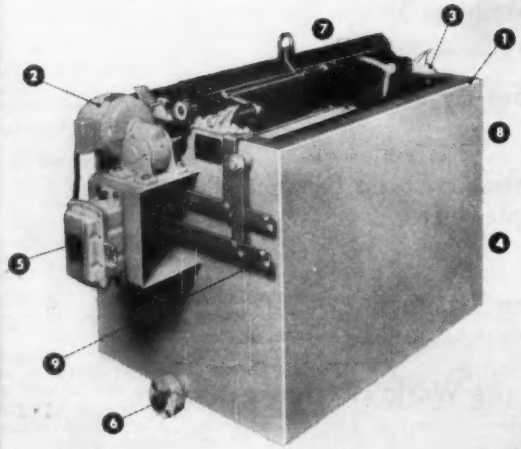

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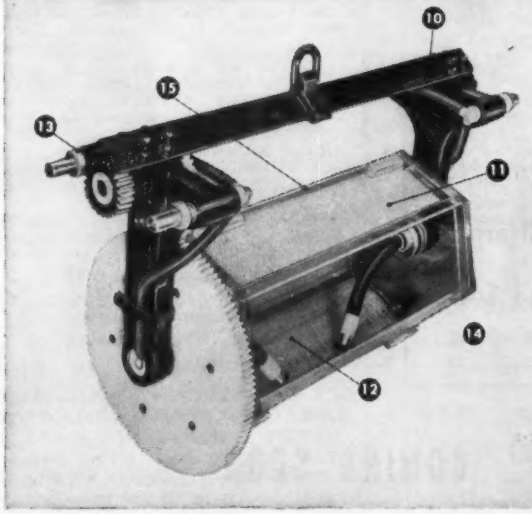

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ESTABLISHED 1903

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

METAL FINISHING

VOLUME 52 • NUMBER 2 • FEBRUARY, 1954

The Materials Outlook -- 1954

The outlook for the coming year appears to be very promising, barring unforseen global developments, except in the case of nickel and nickel chemicals. The hectic and often frantic scramble for scarce materials during the height of the Korean hostilities, which will long be remembered, appears to be a thing of the past and industry's problem will be to sell the finished product, not to obtain the raw materials.

Steel, aluminum and copper, the basic metals, are in excellent supply, as are zinc, lead, tin and cadmium. Prices have, in general, dropped as we predicted a year ago. The availability of these metals has contributed to an easing in the equipment situation, resulting in quicker deliveries by fabricators. Long postponed plant improvements are now being scheduled, therefore, with reasonable certainty of being completed on time.

Especially in the East, a number of importers have begun to exhibit a new interest in the needs of the plater, searching out foreign stocks and suppliers of the staple chemicals for sale in the U. S. market at competitive prices. Cyanides, nickel salts, and anodes are arriving of sufficiently high purity to meet most plating requirements as to quality.

The supply situation with respect to nickel salts has improved to a very noticeable degree and it is not believed that the recent removal of governmental restrictions on end use will have more than a very transient effect. Born of necessity, improved conservation practices such as better draining of plating racks and employment of recovery rinses have shown operators that they can get along very nicely on less than they had previously considered their irreducible minimums.

Industry is now resigned to the fact that the nickel anode situation is going to improve very, very slowly and is operating accordingly. At present, about 40 percent of base period use is all that can be hoped for, if distribution of available supplies is equitable. With the use of a heavier undercoat of copper, of which there is now no shortage, we should be able to manage fairly well, although not as well as we'd like to.

If the present trend continues, which nothing on the immediate horizon would seem to disprove, the New Year will be one of near normalcy with respect to supplies. We will have our fingers crossed.

Nathaniel Hall

Descaling the Stainless Steels

By Lester F. Spencer

THE various grades of stainless steels, upon exposure to a relatively high temperature and a variety of furnace atmospheres, will develop an adherent oxide formation on the exposed surfaces of the part. As can be logically assumed, the complexity of this scale formation is attributed, to a large extent, to the chemical composition of the material; this scale not only including the oxides of the base metal, iron, but also, the oxides of any of the alloying elements within the composition.

The complexity of this scale formation, which is also influenced by both the furnace atmopshere and the temperature-time relationship, will indicate a greater difficulty in removal than that experienced with either the plain carbon or the low alloy steels. Complete removal of this scale is usually imperative since (a) the scale formation will adversely influence the corrosion resistance of the material; and, (b) the scale, even though it may be extremely light in some instances, will cause difficulty in subsequent fabricating operations.

Mechanical Descaling

Among the mechanical methods available for scale removal, abrasive blasting is usually reserved for bulky items where the blast pressure required to remove the scale will not injure the material when reasonable care is taken. Within this category, the blast cleaning methods would include either sand, grit or vapor blast techniques. A procedure, such as exemplified by sand blasting, is usually similar regardless of the material involved. However, in descaling the stainless steels, a high grade silica sand is required; one in which the iron content is as low as commercially possible. In addition, a passivation treatment is usually required so as to eliminate any possibility of surface corrosion due to foreign contamination.

In either grit or sand blast cleaning procedures, the selection of both air blast pressure and abrasive particle size is governed by the physical factors of the item to be descaled. In addition, care must be taken so that a continuous and even movement of blast is realized. Thus, where the blast is directed to any specific area too long, severe localized erosion and surface irregularities may result. In vapor or liquid blasting technique, the size of the abrasive material, which may vary from 100 to 2500 mesh, is usually selected by the type of surface finish that is required on the work.

Mechanical removal of scale may also be accomplished by either tumbling or by wire brushing; the former mentioned method usually being used on small parts where the rotary motion of the tumbling barrel will not distort the part to be descaled, although in recent cases large parts are effectively treated by racking in the barrel so that they do not contact each other. In some instances, especially where the scale formation is quite heavy, tumbling can be used as a preliminary stage in scale removal and is completed by a normal pickling cycle. Thus, it will remove much of the brittle scale and will crack the underlying layers of scale so as to assure complete removal by a subsequent pickling operation. Where this method of scale removal is used to obtain a completely descaled product, it is necessary that a passivation treatment be employed. Mechanical polishing with wheels and belts was covered in a previous article (*Metal Finishing* **51**, 70 (Mar. 1953).

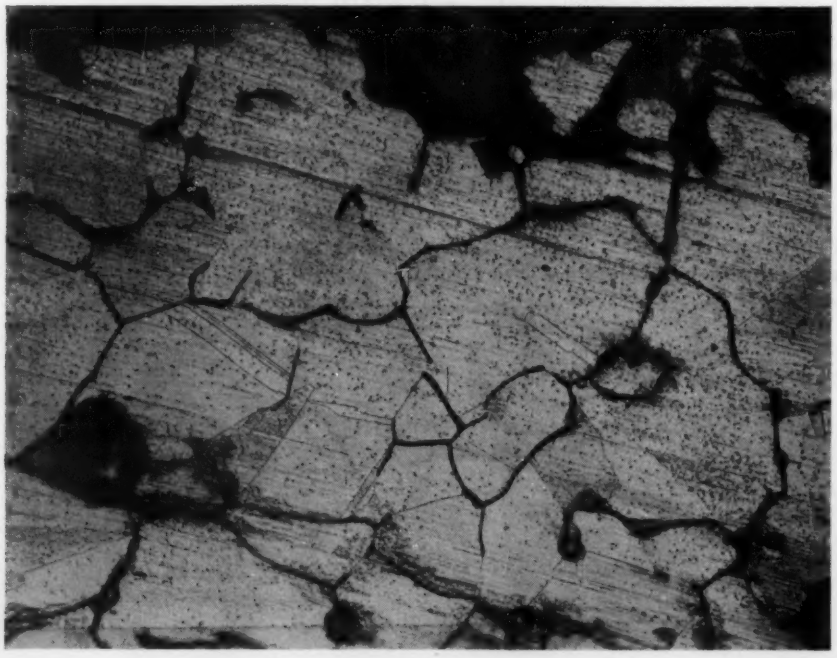


Figure 1. Photomicrograph indicating the effect of pickling sensitized 18-8 stainless in the ferric sulfate-hydrofluoric acid pickling bath.

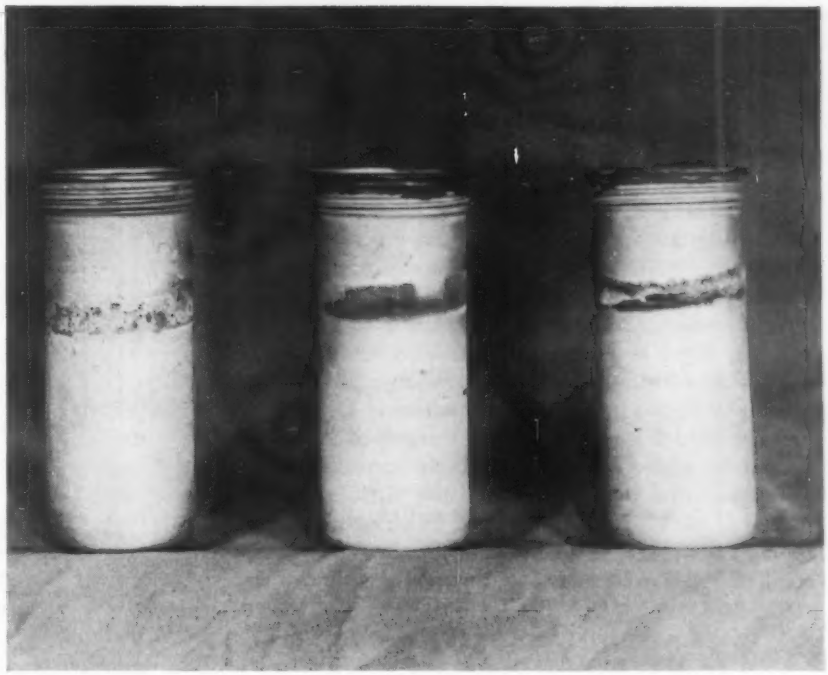


Fig. 2. Pickled shells previously subjected to a flame anneal. The corroded area has been sensitized, resulting in excessive attack when immersed in the ferric sulfate-hydrofluoric acid pickling bath.

Acid Descaling

As in all methods employed in fabricating the various stainless steel compositions, the success experienced in descaling is dependent upon a thorough knowledge of the basic characteristics of these materials. In addition, a thorough study of the scale type and conditions under which it has been produced along with the most effective procedure for removal will eliminate this phase of a production sequence as a 'bottleneck.'

In the event that a mixture of reducing acids is used for descaling, one of the difficulties that may be experienced is that of hydrogen embrittlement; this being especially true with those stainless compositions that have a relatively high carbon content. Thus, those compositions that are classified as the *martensitic* stainless types should never be pickled in the fully hardened condition since pickling cracks may be experienced. It is necessary to stress relieve after a hardening procedure and prior to a descaling treatment. In addition, it is essential that the pickled parts be baked from approximately 300 to 600°F. in order to eliminate service breakage that may otherwise be caused by hydrogen embrittlement. Both the austenitic and the ferritic stainless compositions are apparently not as susceptible to hydrogen embrittlement.

When working with the austenitic stainless steels, it is imperative that the material be chemically clean prior to a heat treatment operation such as annealing. Thus, when this precaution is not observed, a condition known as 'intergranular carbides' will result, reducing the resistance of the material to a corrosive medium. When such parts are subjected to a pickling action, a selective corrosive effect in these sensitized areas occurs which is reflected in high scrap losses.

This intergranular carbide condition is illustrated in Fig. 1; the severity of action of the pickling bath being clearly indicated. Acid attack is definitely along the grain boundaries; the photo-micrograph indicating complete grain separation. Another view of localized acid attack in areas which contain these intergranular carbides is illustrated in Fig. 2; the shells having been flame annealed. In order to minimize the possibility of dirty work entering a furnace in an operation such as annealing, a 100 per cent inspection of all parts under black light is suggested. Any fluorescence will indicate that the shell is not chemically clean.

In the selection of a method for descaling, the essential factor to consider is the selection of a pickling bath which will work most effectively in the removal of the complex scale with, of course, a minimum of metal removal. Other factors that would also influence choice would be that of cost of installation and operation; complexity of operation; and the degree of hazard which may accompany any specific bath composition. Regardless of the choice, it is usually necessary to install a procedure for testing since chemical balance is often synonomous with uniformity of pickled surface.

As is indicated in Table 1, there are numerous formulas available for the pickling of the stainless steels. These acid solutions listed react with the scale formation in two ways. One method is in the nature of a dissolving action where the scale is removed by uniform attack, whereas the other method is by a process of absorption which attacks the metal surface underneath. Although the first method is the preferred, it seldom is practicable in pickling the stainless steels. In the latter method, scale removal is realized by a combination of an undermining of the scale formation and a lifting effect of the hydrogen gas which is liberated during the reaction.

Choosing the Pickle

In the event that heavy scale formations are to be removed, the acid pickling procedure is usually performed in two distinct steps. The first acid bath prepares the scale for removal, whereas the second acid bath actually removes the scale. This can be exemplified by the combination of solution Nos. 1 and 3, used where heavy scale formations are to be removed. Solution No. 3 acts as a scale conditioner after which solution No. 1 is employed in removing the scale deposit. As in any sequence operation, suitable rinses and possibly neutralizers are used between the two baths.

Solution No. 1 is frequently used for descaling the austenitic stainless steels; however strict chemical control is imperative since the bath tends to pit when near exhaustion. The bath is extremely dangerous which

necessitates both the use of exhaust hoods and extreme care in handling and pickling. The ratio of nitric acid to hydrofluoric acid will vary in accordance with the type and condition of scale. A 12:1 to a 15:1 ratio of nitric to hydrofluoric acid is satisfactory where a light scale is to be removed, whereas the ratio may be a good deal lower when removing a heavy scale deposit. As nitric acid inhibits the action of hydrofluoric acid, those solutions which have the greater percentages of nitric acid will also realize a minimum of metal loss during pickling.

In descaling the straight chromium stainless steels, solution No. 4 is frequently used; however it will also tend to pit when near exhaustion. When solution No. 5 is employed, the nitric acid component is kept on the low side and a small amount of commercial inhibitor should be added to the bath. Both precautions will minimize metal loss. However, if the nitric acid component is too low, the dull pickled finish obtained may be objectionable. Where the scale formation is heavy, solution No. 4 can be used as the scale conditioner and solution No. 5 can be employed to remove the scale formation.

Table 1
Acid Pickling Baths for Stainless Steels

Solution No. 1	
Nitric Acid (Sp. Gr. 1.42)	8 to 20 percent by volume
Hydrofluoric Acid	1 to 4 " " "
Water	Balance
Operating Temperature	130-150°F.
Solution No. 2	
Hydrochloric Acid	10 percent by volume
Nitric Acid	5 " " "
Sulphuric Acid	2½ " " "
Inhibitor	0.2 " " "
Water	Balance
Operating Temperature	180-190°F.
Solution No. 3	
Sulphuric Acid (Sp. Gr. 1.84)	6 to 8 percent by volume
Hydrochloric Acid (Sp. Gr. 1.19)	2 to 4 " " "
Water	Balance
Operating Temperature	140-160°F.
Solution No. 4	
Sulphuric Acid (Sp. Gr. 1.84)	10 percent by volume
Water	90 " " "
Rock Salt	¼ lb. per gal. of solution
Operating Temperature	160-180°F.
Solution No. 5	
Hydrochloric Acid (Sp. Gr. 1.19)	25 percent by volume
Nitric Acid (Sp. Gr. 1.42)	3 " " "
Water	Balance
Operating Temperature	140-160°F.
Solution No. 6	
Hydrochloric Acid	20 percent by volume
Nitric Acid	5 " " "
Phosphoric Acid	5 " " "
Inhibitor	0.2 " " "
Water	Balance
Operating Temperature	180-190°F.
Solution No. 7*	
Commercial Ferric Sulfate	6- 8%
Hydrofluoric Acid (100% basis)	1.8-2.0%
Water	Balance
Operating Temperature	160-180°F.

*The details of this process are covered by U. S. Patents No. 1,859,734 and No. 1,899,734.

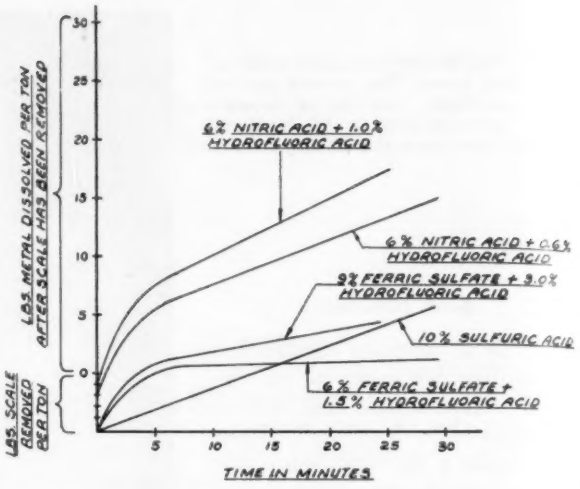

LBS. METAL DISSOLVED PER TON AFTER SCALE HAS BEEN REMOVED
LBS. SCALE REMOVED PER TON
6% NITRIC ACID + 1.0% HYDROFLUORIC ACID
6% NITRIC ACID + 0.6% HYDROFLUORIC ACID
9% FERRIC SULFATE + 3.0% HYDROFLUORIC ACID
10% SULFURIC ACID
6% FERRIC SULFATE + 1.5% HYDROFLUORIC ACID
TIME IN MINUTES

FIG. 3 METAL LOSS IN VARIOUS PICKLING AGENTS
24 GA. COLD ROLLED 18-8 STAINLESS STEEL, (TYPE 302)
CONCENTRATIONS AS 100% ACIDS; TEMPERATURE: 155°F

Solution No. 2 can be used when a satin finish is desired; however, as indicated, the addition of an inhibitor will minimize metal loss during immersion. Solution No. 6 can be used when a luster finish is desired; an inhibitor being recommended as an addition. Both of these solutions work equally well on all the grades of stainless.

The ferric sulfate - hydrofluoric acid pickling bath (solution No. 7) has been used for a considerable number of years at Landers, Frary & Clark. It is a single solution operation used for the austenitic stainless steels; the operational procedure consisting of immersion of the work in the pickling solution which is then followed by a water rinse and then power brushing of each piece to remove the smut. This objectional feature of brushing of each piece may be eliminated by the use of a nitric acid dip. The essential features of this procedure of descaling are:

(a) the time for pickling, as compared to the previous acid baths under discussion, is a good deal shorter. Thus, this time varied from 10 minutes for a light to medium scale to about 15 minutes for a heavy scale.

(b) Fume hoods are not required since the reaction of the two principal ingredients comprising the bath produce a reaction product which is non-fuming, and, in addition, is harmless to the skin and surrounding equipment. This fact has made it possible to place the pickling tanks in close proximity to either furnace or press equipment.

As in all of the pickling baths under discussion, the material descaled should be completely free from intergranular carbides; otherwise, the corrosion rate in the sensitized areas is extremely rapid. This rapidity of acid attack has been illustrated in Fig. 2. Thus, where a stainless pickling basket is employed, the welded construction is not approved unless the basket is either fully annealed to remove any intergranular carbides or the material used is a stabilized stainless steel such as either types 347 or 321. Stainless type 316 has served satisfactory as basket material; the preferred construc-

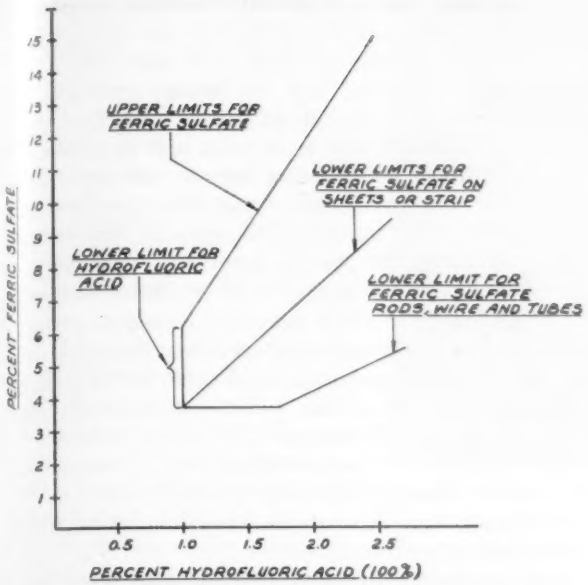

UPPER LIMITS FOR FERRIC SULFATE
LOWER LIMITS FOR FERRIC SULFATE ON SHEETS OR STRIP
LOWER LIMIT FOR HYDROFLUORIC ACID
LOWER LIMIT FOR FERRIC SULFATE RODS, WIRE AND TUBES
PERCENT FERRIC SULFATE
PERCENT HYDROFLUORIC ACID (100%)

FIG. 4. OPTIMUM CONCENTRATIONS FOR FERRIC SULFATE AND HYDROFLUORIC ACID; PICKLING TYPE 302 (18-8) STAINLESS STEEL

tion is one that is bolted. The pickling tank may be constructed of steel which is suitably protected by a lining of tellurium lead. Due to the difficulty that may be experienced in the 'creep' of this material after being in service, it is strongly advised that the lead lining be held firmly in position by supporting 'U' buckles which have been previously coated with lead; these buckles being placed in the tank about 14 inches apart.

A comparison in the rate of metal attack between two concentrations of the ferric sulfate - hydrofluoric acid bath and other acid mixtures are given in Fig. 3. As is indicated, the ratio of 6.0 ferric sulfate to 1.5 hydrofluoric acid results in a minimum of metal loss when compared to the other solutions. This fact was one of the reasons that this bath had been chosen for the descaling of the austenitic stainless compositions. However, as previously mentioned, strict chemical control is required to maintain a properly balanced solution so as to maintain this minimum metal loss during the descaling operation. Thus, where the ferric sulfate and hydrofluoric acid are permitted to rise to a value of 9.0 and 3.0 respectively, a rapid attack of the base metal will result.

A number of observations on the operation of this bath may be given. Thus, during a pickling cycle, the ferric sulfate component will be used up quite rapidly; which requires almost daily additions depending both upon the size of the tank and the number of square feet of material descaled. A correlation between the number of square feet of descaled area and the additions can be readily worked out since a straight line relationship exists. Usually, when a reddish deposit of ferric oxide covers the work, this occurring in conjunction with a slow pickling rate, the bath needs additions of ferric sulfate.

When the activity of the bath decreases and there is no indication of this reddish ferric oxide on the work, the acid component is usually low. This component is used up much more slowly than the ferric sulfate addition. Since, during the pickling cycle, the ferrous sulfate builds up, there is a limit to in which this bath will operate efficiently. Thus, when the ferrous sulfate content within the bath is around 20 percent, the bath must be discarded. It is necessary to conduct daily chemical checks of the pickling bath in order to assure efficient operation; a suggested relationship between the two components of the bath being given in Fig. 4.

Caustic Descaling Baths

The use of molten caustic as a method of descaling is becoming quite popular; the advantage realized in the use of this type of descaling bath is that it is extremely versatile. Thus, a molten caustic descaling bath can be used for a variety of materials including the stainless steels of all types, the high nickel alloys, the tool steels, the standard S.A.E. and N.E. steels and other metals and alloys which will not react to fused caustic and whose properties or characteristics are not adversely affected by the temperature of operation. In the use of the caustic descaling bath for the austenitic stainless steels, another advantage is gained in that no metal attack will occur even though sensitized areas are present in the material to be descaled.

The sodium hydride descaling process is one of the baths of this nature that is commercially available. In this process, the metal to be descaled is immersed in molten caustic soda usually containing 1.5 to 2.0 percent sodium hydride which is produced by reacting metallic sodium and hydrogen. The descaling reaction of the sodium hydride is directly opposite to scale

Figure 5. Sodium hydride descaling tank.

(Courtesy E. I. du Pont De Nemours & Co., Wilmington, Del.)

formation by oxidation in that the scale is reduced to a metal or to a lower oxide, the major portion of which is flaked off during a subsequent quench in water. Water washing follows and a short acid dip will produce a bright, clean surface.

An installation, as illustrated in Fig. 5, shows the descaling tank. As can be seen, the tank is provided with cubicles on one side, usually termed generators, where the metallic sodium and hydrogen react to form the sodium hydride. This sodium hydride emerges from the generators and is diffused uniformly throughout the bath by the action of convection currents and by agitation resulting from introducing and withdrawing the work. The bath temperature is at 700° ± 20°F. and the duration of immersion is dependent upon the type of material being handled, the type of scale on the surface of the work, and the amount of scale that is present. This period of time may vary from a few seconds to as high as 20 minutes. However, there is no danger of overtreatment since the reaction ceases when reduction is complete. In some instances, pre-heating the work prior to immersion will reduce the time of immersion.

A typical cleaning cycle may be as follows, thus: (a) descale in sodium hydride (1.5 to 2.0%) — caustic soda (98% plus) bath for 10 to 15 minutes; (b) water quench and rinse; (c) acid dip, 10% sulfuric acid for 2 to 4 minutes; (d) water rinse; (e) acid dip, 10% nitric acid for 2 to 4 minutes. In some instances, a 1 to 2% hydrofluoric acid is added to obtain a 'bleached' finish on some grades; and, (f) high pressure rinse. This descaling cycle will undoubtedly be modified to some extent in accordance to the specific application, however the information given above can be used. The critical element is the sodium hydride content which is controlled by periodical chemical checks and adjusting the sodium feeds accordingly.

As to equipment, the descaling tank may be made from low carbon steel; the tank being heated by the conventional methods employed for the heating of salt baths. Thus, external gas or oil burners, gas fired immersion tubes, external electrical resistance elements, or internal immersion electrodes or resistance elements can be used. The generators are also made from a low carbon steel material and are usually mounted on brackets along the side of the caustic tank. Each generator is equipped with a gas pilot light to ignite the excess hydrogen as it escapes from the generator box. The reduced material, which results from the descaling action and drops into the bath, may be removed by dredging or by the use of a perforated sludge pan designed to rest on the bottom of the descaling tank.

Hydrogen or cracked ammonia is added continuously to the generator during operation. Ammonia dissociator capacity amounting to 15 cubic feet of cracked gas per pound of sodium added (at maximum feed rate) to the bath is required. If bottled hydrogen is used, 10 to 12 cubic feet should be available per pound of sodium consumed. Graphite is usually used as the bath cover, a grade having a low silica content being recommended.

The usual safety precaution for operating fused baths and handling hydrogen or cracked ammonia gas must be observed. It is essential that water does not come in contact with either the metallic sodium or the molten caustic bath. Sodium barrels, both empty and full, should be stored in a dry, clean room which has a good roof and no automatic sprinkling system. Water must not be used in this storage area. In addition, operators should wear goggles or face shields and proper protective clothing when either operating the bath or when handling metallic sodium.

Another fused bath process is also a caustic bath with the same applications for descaling as listed for the sodium hydride bath. However, in this process there is no need for the addition of either metallic sodium, dissociated ammonia or hydrogen to produce the essential sodium hydride. The operational procedure is about the same in that the work to be descaled is immersed in the molten caustic for a period of time varying from 1 to 15 minutes; the actual time depending upon such factors as the type material to be descaled, the composition and the thickness of the scale and both the size and shape of the part. It is then given a drastic quench in water after which it is submitted to an acid or brightening dip. In descaling the various stainless compositions, the brightening dip is a two phase process; the first dip is in either dilute muriatic or dilute sulphuric acid from 1 to 5 minutes, whereas the second dip is in dilute nitric acid which both brightens and passivates the surface. It is then pressure sprayed with water.

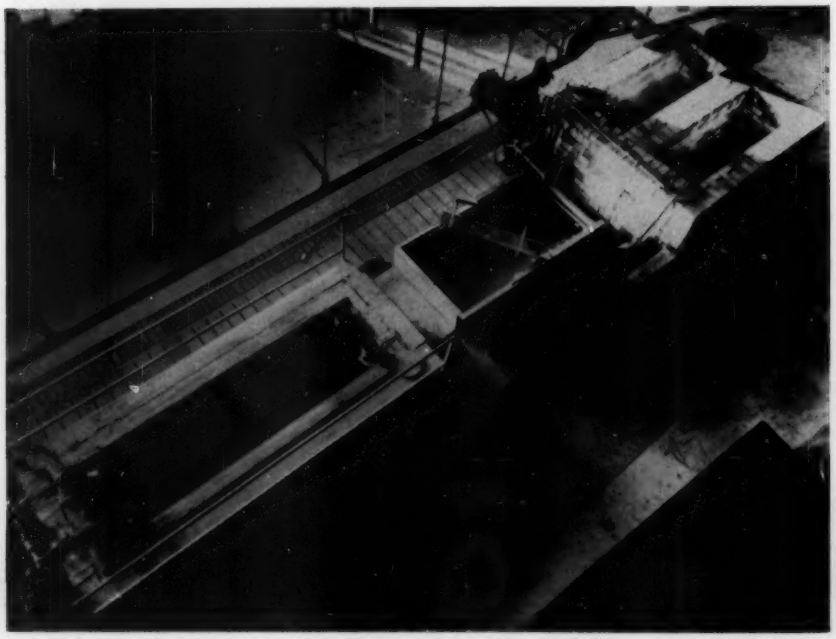
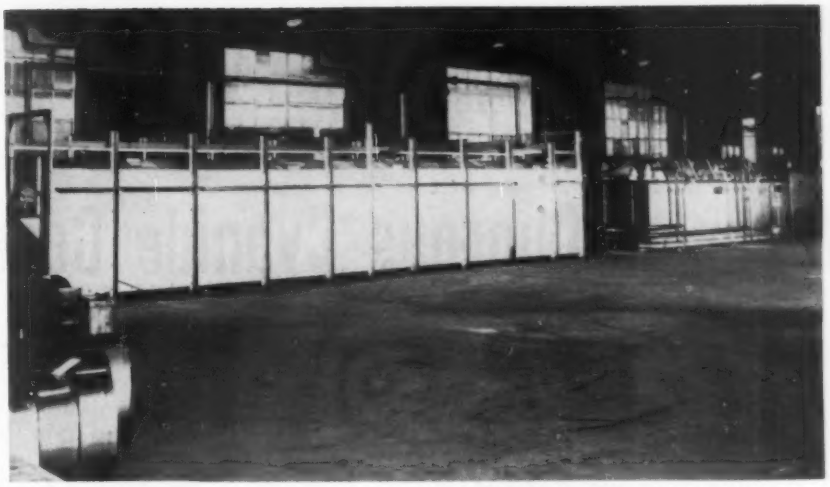


Figure 6. Typical fused bath layout. From left: Salt dip; water quench; acid dip tanks.

(Courtesy Hooker Electrochemical Company, Niagara Falls, N. Y.)

Figure 7. Continuous stainless strip annealing and descaling line. Furnace on left followed by salt descaling bath.



(Courtesy Drever Company, Philadelphia, Pa.)

The descaling salt has oxidizing agents which chemically change the composition of the adhering scale, causing the scale to swell up and become more readily soluble in acid. Since the normal bath temperature during operation is 930° F., the resultant expansion that occurs during heating and the contraction which occurs during the water quench will cause cracks and separations in the scale. This permits better acid penetration during the subsequent acid dip. The sole addition agent during operation is replacement of the salt which has been lost through drag-out. In addition, due to the self regeneration of the bath, no chemical supervision is necessary.

As mentioned previously, the normal operating temperature of this caustic bath is at 930°F.; however, there have been occasions where a temperature as low as 800°F. has been used successfully. Here again, sludge trays are used to catch any loose material which may fall into the bath during its operation. A suggested standby temperature is 650°F. but, when necessary, the bath may be allowed to solidify.

As in the sodium hydride process, descaling, utilizing the oxidizing process, can be performed as either a batch type operation, or as a continuous process. As is illustrated in Fig. 6, which is a typical process layout, the molten salt descaling bath is at the extreme left which is followed in order by a water quench and then an acid dip. A line for continuously annealing and descaling straight chromium and chromium-nickel strip is shown in Fig. 7.

Conclusion

Scale deposits on the stainless steels are difficult to remove; this necessitates the use of strong acid solutions along with lengthy periods of time. Thus, production wise, it is frequently good policy, especially where the volume of pickling is moderately high, to carefully investigate this operation so that (a) a minimum of time is required to descale the item; (b) a minimum of scrap loss is obtained through intergranular carbide precipitation or by lengthy immersion times in the descaling bath; and, (c) to obtain a descaling method which will have both an initial low cost for set-up, low maintenance and a minimum of chemical control.

Although considerable work can be accomplished in the actual descaling operation, some thought should also be placed on the composition and thickness of the scale deposit. Thus, it is generally accepted that a scale condition is directly influenced by the furnace atmosphere to which the parts are subjected and both the time and temperature at heat. In the establishment of a uniform scale condition and a scale composition that can be removed in a minimum of time, it is suggested that both the furnace type used for heat treatment and the furnace atmosphere under which heat treatment is performed be thoroughly investigated.

In regard to furnace type, the essential factor for uniformity of scale is that the furnace be uniform in temperature within the heating zone whether it be a batch or continuous type furnace. It is realized that production requirements will have a deciding influence on the choice of furnace type; however, it has been our experience that the most uniform scale condition is that which is obtained in a continuous conveyor type furnace. The furnace atmosphere also has a decided influence in determining the composition of the scale. Thus, in our experience, short of bright annealing which produces no scale, an endothermic atmosphere will condition the resultant scale so that it can be removed easily in a minimum of time. Our experiences with this furnace atmosphere type has been obtained in conjunction with the ferric sulfate - hydrofluoric acid bath.

It is realized that each individual plant must undergo an experimental stage to determine the suitability of both furnace capacity, furnace type and furnace atmosphere and determine the improvement of descaling, on the basis of costs, by deviating from standard practices. Thus, additional equipment costs to improve the scale condition must be justifiable on a cost basis. However, it is suggested that the above factors be investigated. As to the descaling medium, there are a variety of acid solutions that may be used to advantage. Here again, the advances made in the descaling procedures for the stainless steels, notably in the use of molten caustic, should be thoroughly investigated to determine the possible advantages gained in the specific application.

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Complex Cuprous Cyanide Compounds

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Introduction

AS is well known, monovalent copper has a very strong tendency to form complexes with cyanide groups. These compounds might be supposed to have the metal attached either to the carbon or the nitrogen atom of the cyanide radical. It is, however, nowadays accepted that the metal atom generally is attached to the cyanide group through the carbon, i.e. the constitution formula of the complex $Cu(CN)_3^{=}$, for example,

would be $Cu\begin{cases} -C\equiv N \\ -C\equiv N \\ -C\equiv N \end{cases}$ [1, 2, 3]

Many investigations have been carried out on the compositions of the complexes formed in cyanide copper plating baths. It is the aim of this paper to give a review of these investigations and present the contemporary ideas regarding these complexes. Further, the formulas of the solid cuprous cyanides, used for preparing the alkaline copper plating baths, are given. Finally some experiments regarding the stability of the complex copper cyanide ions are presented.

Solid Alkali Copper Cyanide Salts

Many different copper cyanides exist in the solid state. For cyanide copper plating baths the double salts with the alkali metals are used almost exclusively and, for this reason, only these salts are described here.

In general, the potassium cuprous cyanides have been prepared but also the double salts with the other alkali metals. Grossman and von der Forst[4] have made a very detailed investigation of the alkali copper cyanide compounds. According to these authors the various types of these salts are (R representing the alkali metal): a) $RCu_2(CN)_3$; b) $R_2Cu_3(CN)_5$; c) $RCu(CN)_2$; d) $R_2Cu(CN)_3$ and e) $R_3Cu(CN)_4$. In these salts the copper content decreases and the alkali metal content increases from a) to e).

The salts which have the greatest interest for the electroplating industry are the potassium and sodium salts, which are of the following types:

a) *$RCu_2(CN)_3$:* $KCu_2(CN)_3{\cdot}H_2O$ was obtained, as also described by Itzig,[5] through reaction between copper rhodanide, CuSCN, and potassium cyanide, KCN. The corresponding sodium salt, $NaCu_2(CN)_3{\cdot}H_2O$, was obtained through saturation of a rather concentrated water solution of sodium cyandide, NaCN, (at least 10 grams NaCN in 150 ml.) with cuprous cyanide, CuCN. More diluted solutions give compounds of type c), that is, $NaCu(CN)_2$.

b) *$R_2Cu_3(CN)_5$:* Of this type neither the potassium nor the sodium salt could be isolated.

c) *$RCu(CN)_2$:* Also of this type both the potassium and sodium salts have been obtained. The formulas are $KCu(CN)_2$ and $NaCu(CN)_2{\cdot}2H_2O$ respectively. As has been mentioned above, the sodium salt is obtained through reaction between cuprous cyanide and sodium cyanide.

d) *$R_2Cu(CN)_3$:* Of this type only the sodium salt, $Na_2Cu(CN)_3{\cdot}3H_2O$, but not the potassium salt could be isolated.

e) *$R_3Cu(CN)_4$:* Both the potassium and the sodium salts were prepared, the formulas of which are $K_3Cu(CN)_4$ and $Na_3Cu(CN)_4{\cdot}3H_2O$ respectively. They were obtained through dissolving cuprous cyanide in solutions of the corresponding alkali cyanides.

The other chemists who have investigated the complex alkali cuprous cyanides have come to the same results as Grossman and von der Forst regarding the composition of these salts. Kunschert[6] found the following salts: $KCu(CN)_2$, $KCu_2(CN)_3{\cdot}H_2O$ and $K_3Cu(CN)_4$, which are also reported by Brigando.[7] In addition to these Itzig[5] also mentions a potassium salt with the formula $K_2Cu_3(CN)_5$ and Treadwell and von Girsewald[8] report a potassium salt with the formula $K_2Cu(CN)_3$, which Grossmann and von der Forst did not succeed in isolating. It may be mentioned that, in one of the papers above, the salt $KCu_2(CN)_3$ is said to be very slightly soluble, the solubility being 0.59 grams/liter at 15°C.[8] The same has also been reported about the salt $KCu(CN)_2$ by Spitzer,[9] according to which the solubility is only 0.04 mol/liter, i.e., 6.2 grams/liter at 18°C.

Finally it may be mentioned that Basset and Corbet,[10] who have made a phase rule study of various metal cyanides of potassium arrived at the same results regarding the composition of the potassium cuprous cyanides as Grossman and von der Forst.

From the review above it appears that various potassium and sodium salts of copper cyanide exist, the copper content of which varies very much. This is seen from Table I in which the percentage of copper in the different salts are shown. The percentage refers to the salts without water of crystallization.

TABLE I

Composition	Percentage of copper	Composition	Percentage of copper
$KCu_2(CN)_3$	52.0	$NaCu_2(CN)_3$	55.8
$KCu(CN)_2$	41.1	$NaCu(CN)_2$	45.9
$K_2Cu(CN)_3$*	35.5	$Na_2Cu(CN)_3$	33.9
$K_3Cu(CN)_4$	22.3	$Na_3Cu(CN)_4$	26.9

In the table the salt $K_2Cu(CN)_3$ is included, although, according to Thompson,[15] this salt has apparently never been isolated.

Complex Cuprous Cyanides in Water Solutions

The composition and stability of the complex ions which are formed when cuprous cyanide is dissolved in solutions containing cyanide ions has been of interest to chemists for a long time. As early as 1904 Treadwell and Girsewald[8] investigated the possibility of precipitating cuprous sulfide, Cu_2S, through saturation of water solutions of various potassium cuprous cyanides with hydrogen sulfide, H_2S. From the experiments it was clear that when potassium cyanide was present, copper could not be precipitated as cuprous sulfide with hydrogen sulfide if complex ions, containing more cyanide than $Cu(CN)_2^-$ were formed, i.e. $Cu(CN)_4^{\equiv}$ and most probable $Cu(CN)_3^=$. According to these investigations the ions $Cu(CN)_3^=$ and $Cu(CN)_4^{\equiv}$ are the most stable, whereas the ions containing less cyanide are dissociated into copper and cyanide ions to such a degree that the solubility product of cuprous sulfide is exceeded and the sulfide precipitates. From the solubility product of cuprous sulfide and the solubility of hydrogen sulfide in water an estimation of the concentration of the cuprous ions in the solution can be made. The amount is found to be less than 10^{-21} grams per liter in solutions containing $Cu(CN)_3^=$ and $Cu(CN)_4^{\equiv}$ ions.

Kunschert[6] attacked the problem from another point of view. He measured the electromotive force between electrodes in solutions of potassium cyanide. To one of these solutions cuprous cyanide was added, through which part of the free cyanide was bound under formation of complex ions. The electrode in this solution hence was positive to the other electrode. From the values of the e.m.f. obtained by these measurements the amount of free cyanide in the solution could be estimated and, hence, the compositions of the complexes formed. Similar experiments were also made with mercury electrodes. From these investigations Kunschert inferred that the principal complex is $Cu(CN)_4^{\equiv}$, which, at diminished amounts of potassium cyanide, dissociates to $Cu(CN)_3^=$ and free cyanide. It is also possible that the ion $Cu(CN)_2^-$ is present in the solution. Kunschert was also able to determine the dissociation constant k for $Cu(CN)_4^{\equiv}$, defined as $k = \frac{[Cu^+]\,[CN^-]^4}{[Cu(CN)_4^{\equiv}]}$; k was found to be 2×10^{-27}, which means that a solution, in which the potassium cyanide is normal and the cuprous concentration is decinormal, has a concentration of free cuprous ions of only 5×10^{-29}. The complex $Cu(CN)_4^{\equiv}$ is, therefore, very strong. Brigando[7] arrived at the same result, finding that this complex is only slightly dissociated according to the formula $Cu(CN)_4^{\equiv} \rightarrow Cu(CN)_3^= + CN^-$.

Grossmann and von der Forst[4] investigated the lowering of the freezing point in solutions of $K_3Cu(CN)_4$ and $Na_3Cu(CN)_4$ in concentrations of 2-9 grams per liter. It was shown from their investigations that the lowering of the freezing point corresponded to a formation of $3K^+$ and $3Na^+$ ions respectively plus $Cu(CN)_4^{\equiv}$ ions, i.e. the complex ion $Cu(CN)_4^{\equiv}$ was not dissociated to a higher degree at this concentration.

As is seen from the above, most of the older authorities who have investigated dilute solutions of the complex cuprous cyanides, have found the most important and most stable ion to be $Cu(CN)_4^{\equiv}$ and that the other complex ions are formed only to a minor degree. However, Hönig[11] has already reported the principal ions formed in solutions of this type to be $Cu(CN)_2^-$ or $Cu(CN)_3^=$ depending on the amount of alkali cyanide added. This is in agreement with present ideas regarding the complex ions in cyanide copper plating baths.

Later papers dealing with the constitution of complex cuprous cyanides usually have reference to the electrodeposition of copper. A very important study has been published by Glasstone.[12] The free cyanide content of solutions of cuprous cyanide in potassium cyanide and in sodium cyanide was determined by electrometric titration. It was concluded that both $Cu(CN)_2^-$ ions and $Cu(CN)_3^=$ ions are formed in a considerable degree. However, when 2 equivalents of cyanide ions have been added per equivalent of cuprous cyanide, it is stated that the whole of the copper is present in the form of $Cu(CN)_3^=$, the addition of more alkali cyanide having only a very gradual influence on the ions present in the solutions. Glasstone also found that 1 equivalent of cuprous cyanide requires 1.5 equivalents of alkali cyanide for complete dissolution. If the only complex ion formed is $Cu(CN)_2^-$, 1 equivalent of cuprous cyanide would require only 1 equivalent of alkali cyanide for dissolution according to the formula: $CuCN + RCN \rightarrow RCu(CN)_2$. If, on the other hand, the only complex formed is $Cu(CN)_3^=$ 1 equivalent of cuprous cyanide would require 2 equivalents of alkali cyanide for dissolution according to the formula: $CuCN + 2RCN \rightarrow R_2Cu(CN)_3$. The fact that 1.5 equivalents of alkali cyanide are required for the dissolution of 1 equivalent of cuprous cyanide shows that both $Cu(CN)_2^-$ ions and $Cu(CN_3^=$ ions are formed to about the same extent.

The above refers to solutions of cuprous cyanide in both sodium cyanide and potassium cyanide at low concentrations. At higher concentrations of potassium cuprous cyanide the principal ion is $Cu(CN)_3^=$ as the compound $KCu(CN)_2$ is slightly soluble. In a later paper[13] Glasstone again emphasizes that in sodium copper cyanide solutions the compounds formed are $NaCu(CN)_2$ and $Na_2Cu(CN)_3$.

As has been stated above, the most important cuprous cyanide complex formed is $Cu(CN)_3^=$ when two equivalents of alkali cyanide are added to one equivalent of cuprous cyanide. As this condition is almost always fulfilled in copper-plating baths the most impor-

tant ion in these must be $Cu(CN)_3^{=}$. This seems also to have been accepted by almost every worker in this field. Petrocelli[14] in his study of the electrolysis of sodium cupro-cyanide solutions supposed the composition of the compound to be $Na_2Cu(CN)_3$ and Thompson[15] names the ion $Cu(CN)_3^{=}$ "the chief metal-bearing ion." In a review, Bandes[16] gives a table containing formulas of cuprocyanide plating solutions. From the data in this table on the concentrations of cuprous cyanide, total alkali cyanide and free cyanide (i.e. the cyanide which is not bound to the copper cyanide complex) the ratio Mol bound NaCN: Mol CuCN can be estimated. Although the concentrations of copper cyanide and the amounts of free cyanide vary very much in the solutions, this ratio is very near 2 in all cases, which means that the reactions follow the equation: $CuCN + 2RCN \rightarrow R_2Cu(CN)_3$. Hence, it can be concluded that most copper is bound as $Cu(CN)_3^{=}$. This is also the opinion of the author in question. Also Bonner and Kaura[17] state that the complex ion in copper-cyanide baths is almost exclusively $Cu(CN)_3^{=}$ and Pan[18] found that in concentrated copper cyanide plating baths the combined cyanide turned out to be in accordance with the formula $Na_2Cu(CN)_3$. It may also be mentioned that two Russian investigators, Plaksin and Fishkova,[19] who have studied the solubility of copper cyanide in sodium and potassium cyanide, assume the formation of $Na_2Cu(CN)_3$ and $K_2Cu(CN)_3$ respectively in industrial cyanide plating baths in the presence of an excess of alkali cyanide.

From the above it is seen that various complexes are formed when cuprous cyanide is dissolved in alkali cyanide solutions according to the following formulæ:

$$CuCN + CN^- \rightarrow Cu(CN)_2^-$$
$$CuCN + 2CN^- \rightarrow Cu(CN)_3^{=}$$
$$CuCN + 3CN^- \rightarrow Cu(CN)_4^{\equiv}$$

These complex ions are in equilibrium with each other according to the following scheme:

$$Cu(CN)_2^- + CN^- \rightleftarrows Cu(CN)_3^{=}$$
$$Cu(CN)_3^{=} + CN^- \rightleftarrows Cu(CN)_4^{\equiv}$$

As has been stated above the most important complex ion is $Cu(CN)_3^{=}$ when two and more equivalents of alkali cyanide have been used to dissolve one equivalent of cuprous cyanide, the other complex copper ions being present only to a minor degree. Because more than two equivalents of alkali cyanide are generally used to dissolve one equivalent of cuprous cyanide in cyanide copper plating baths, the most common copper ion in these solutions is consequently $Cu(CN)_3^{=}$.

Experimental

A very important question regarding the complex ions in cyanide copper plating baths is how the complex ions behave when pH, temperature and concentrations are changed. Three cases are then possible: a) the complex ions remain unchanged; b) free cyanide is added, e.g. according to the formula: $Cu(CN)_3^{=} + CN^- \rightarrow Cu(CN)_4^{\equiv}$; c) the complex ions disintegrate with formation of free cyanide, e.g. according to the formula: $Cu(CN)_3^{=} \rightarrow Cu(CN)_2^- + CN^-$. It was the aim of this experimental part to investigate these problems. The experiments were performed in the following manner: Very pure cuprous cyanide was accurately weighed and dissolved in solutions of known amounts of very pure sodium cyanide. The amount of free cyanide was then determined in the usual way through titration with standard silver nitrate solution, using potassium iodide as indicator. This manner of determining the free cyanide content is not very accurate, according to Senderoff[20] but, according to Thompson[15], this method gives approximative results. Pan[21] determined the free cyanide in brass plating solutions by four different methods, among them titration with silver nitrate, and found that the different methods gave good agreement among themselves. The titration with silver nitrate seems, therefore, to give a rather good estimation of the free cyanide content in the plating baths and, as this method is the one generally used for the control of plating solutions, it was chosen in these investigations. However, as several authors have pointed out, it is very important that the same amount of potassium iodide be used for every titration, if the results are to be comparable.

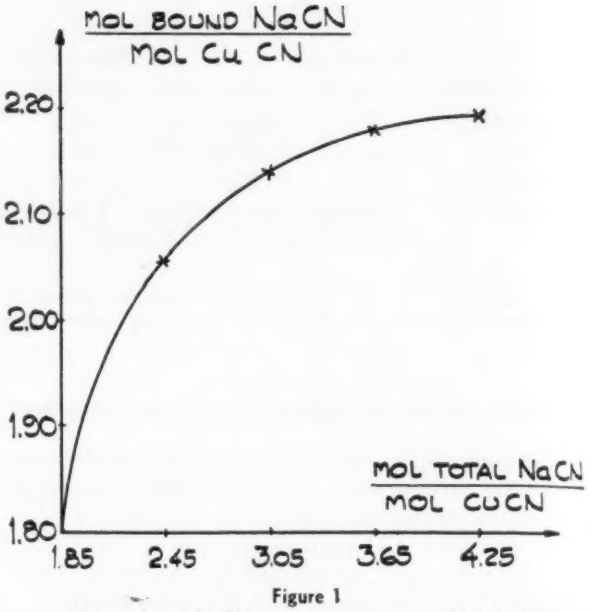

Figure 1

Ratio $\frac{\text{Mol combined NaCN}}{\text{Mol CuCN}}$ as a function of ratio $\frac{\text{Mol total NaCN}}{\text{Mol CuCN}}$.

Experiment I.

The purpose of this experiment was to investigate the change of the composition of the complex cuprous cyanide ions with increasing excess of alkali cyanide. 3.00 grams of cuprous cyanide were dissolved in solutions of a volume of 100 ml., containing 3.00, 4.00, 5.00, 6.00 and 7.00 grams of sodium cyanide respectively. The temperature was in all cases 18°C. From the determination of the free cyanide content, the amount of combined sodium cyanide could be estimated. The ratio Mol combined NaCN:Mol CuCN was drawn as a function of the ratio Mol total NaCN: Mol CuCN. The results, which are presented in Figure I, show that, with increasing content of sodium cyanide, the molecular weights of the copper cyanide ions are increased, i.e. the reactions run to the right according to the following reactions:

$$CuCN \xrightarrow{CN^-} Cu(CN)_2^- \xrightarrow{CN^-} Cu(CN)_3^{=} \xrightarrow{CN^-} Cu(CN)_4^{\equiv}$$

This is in accordance with the principle of Le Chatelier which may be stated as follows: Increasing the quantity of a given substance favors the reaction in which this substance is used up.

As is evident from the reaction formulas, a value of the ratio Mol combined NaCN: Mol CuCN = 1 means that the compound formed is $NaCu(CN)_2$; when the ratio Mol combined NaCN: Mol CuCN = 2 means that the complex is $Na_2Cu(CN)_3$ and when the ratio is equal to 3 the compound formed is $Na_3Cu(CN)_4$.

The result stated above, that addition of alkali cyanide causes a shift toward a higher coordination number, has also been reported by Thompson.[15] However, as is seen from the figure, the ratio Mol combined NaCN: Mol CuCN is increased more slowly when the ratio Mol total NaCN: Mol CuCN is increased, which means that, although the ratio Mol total NaCN: Mol CuCN is as great as 4.30 most of the copper is bound as the ion $Cu(CN)_3^{=}$, although the ion $Cu(CN)_4^{\equiv}$ is partly formed. At lower content of cyanide the ion $Cu(CN)_2^{-}$ is also present.

EXPERIMENT 2.

The aim of this experiment was to investigate how the composition of the complex copper cyanide ions changes when the alkali cyanide content is constant but the cuprous cyanide content is increased. 3.00, 4.00, 5.00, 6.00 and 7.00 grams of cuprous cyanide were dissolved in solutions, each of a volume of 100 ml., in which 7.00 grams of sodium cyanide were dissolved. The temperature of the solutions was 18°C. The free cyanide content was determined in each solution and from this the amount of combined sodium cyanide could be estimated. The results are presented in Figure 2, in which the ratio Mol combined NaCN: Mol CuCN is drawn as a function of the ratio Mol CuCN: Mol total NaCN. From this figure it is seen that addition of cuprous cyanide tends to lower the coordination number of the complex, a fact which Thompson[15] also found. However, even if the concentration of cuprous cyanide changes considerably, the coordination number is about 2, which means that the most important ion is $Cu(CN)_3^{=}$.

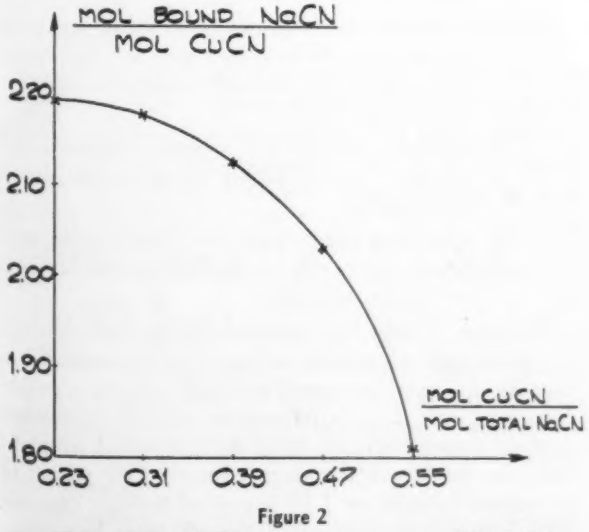

Figure 2

Ratio $\frac{\text{Mol combined NaCN}}{\text{Mol CuCN}}$ as a function of ratio $\frac{\text{Mol CuCN}}{\text{Mol total NaCN}}$.

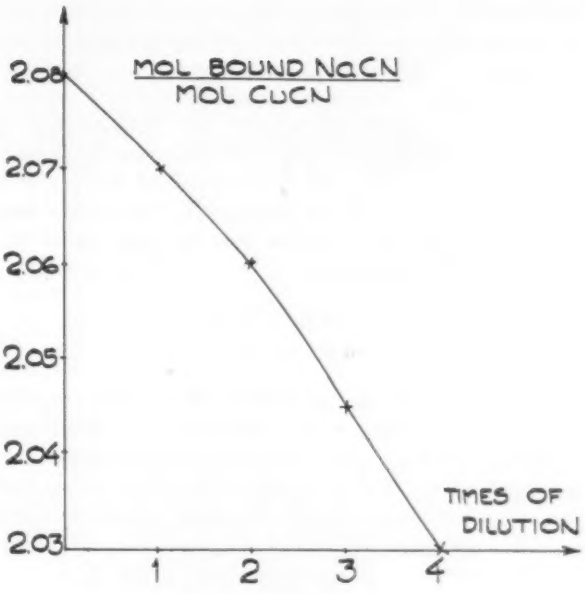

Figure 3

Ratio $\frac{\text{Mol combined NaCN}}{\text{Mol CuCN}}$ as a function of dilution.

EXPERIMENT 3.

This experiment was performed in order to determine the change of the composition of the complex cuprous cyanide ions with increasing dilution of the cyanide copper solutions. The experiment was performed in the following manner: 6.00 grams of cuprous cyanide were dissolved in 100 ml. solution of 8.00 grams sodium cyanide in distilled water. 10 ml. of the solution were titrated directly with silver nitrate in the usual manner and also after dilution with 10, 20, 30, and 40 ml. distilled water respectively. The titrations were performed at 18°C. The results are presented in Figure 3, which shows the ratio Mol combined NaCN: Mol CuCN as a function of the dilution. As is seen from the figure, the free cyanide content is increased with the dilution, i.e. a partial dissociation of the complex ions occurs according to the following reactions: $Cu(CN)_4^{\equiv} \rightarrow Cu(CN)_3^{=} + CN^{-}$; $Cu(CN)_3^{=} \rightarrow Cu(CN)_2^{-} + CN^{-}$. The dissociation is however rather slight, the coordination number being decreased from 2.08 to 2.03 at a dilution to a fivefold volume. The free cyanide content, however is increased at the same time from 11.3 to 13.5 grams per liter. This means that, on analysis of cyanide copper plating baths, the dilution has a certain significance in the determination of the free cyanide content. Hence, in order to get comparable results, the dilution should be about the same at different times.

EXPERIMENT 4.

The purpose of this experiment was to investigate the compositions of the complex cuprous cyanide ions at different pH of the solutions. 3.00 grams of cuprous cyanide were dissolved in a solution containing 4.00 grams of sodium cyanide in 100 ml. distilled water; pH of this solution was 12.5. The free cyanide content was determined by titration in the usual manner. The determination of the free cyanide content was also

carried out in solutions of the same composition, pH of which had been lowered to 11.1 and 8.5 respectively by means of buffer solutions. The solutions were titrated at 18°C. The results are presented in Figure 4, in which the ratio Mol combined NaCN: Mol CuCN is drawn as a function of pH of the solution. As is seen from the figure, the ratio Mol combined NaCN: Mol CuCN diminishes with increasing pH. This means that with higher pH the complex ions are dissociated according to the equations:

$$Cu(CN)_4^{\equiv} \rightarrow Cu(CN)_3^{=} + CN^-$$
$$Cu(CN)_3^{=} \rightarrow Cu(CN)_2^{-} + CN^-$$

which also means that at higher pH the free cyanide content is increased, a fact also noted by Read and Graham.[22] However, as is seen from Figure 4, the dissociation of the higher complex ions and hence the increase of the free cyanide is rather slight, the free cyanide content being increased from 5.5 to 6.0 grams per liter when the pH increases from 8.8 to 12.5.

EXPERIMENT 5.

This experiment was performed in order to investigate how the composition of the cuprous cyanide ions changes with increasing temperature. 3.00 grams of cuprous cyanide were dissolved in a solution of a volume of 100 ml., containing 4.00 grams of sodium cyanide. 10 ml. of this solution were titrated in the usual way at temperatures of 10°, 20° and 40°C. respectively. The results are seen in Figure 5, in which the ratio Mol combined NaCN: Mol CuCN is drawn as a function of the temperature. As is seen from the figure, the ratio Mol combined NaCN: Mol CuCN diminishes with increasing temperature, i.e. the higher coordination compounds are split up according to the eqations: $Cu(CN)_4^{\equiv} \rightarrow Cu(CN)_3^{=} + CN^-$; $Cu(CN)_3^{=} \rightarrow Cu(CN)_2^{-} + CN^-$. Because of this, the free cyanide content is increased when the temperature is raised, which has also been reported by Glasstone,[12] Thompson[15] and Read and Graham.[22] In the experiments above, the increase of the free cyanide content was from 5.7 grams per liter at 10°C. to 6.6 grams per liter at 40°C.

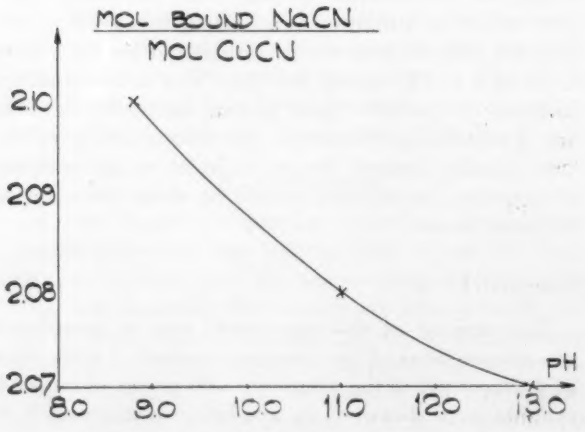

Figure 4

Ratio $\frac{\text{Mol combined NaCN}}{\text{Mol CuCN}}$ as a function of pH.

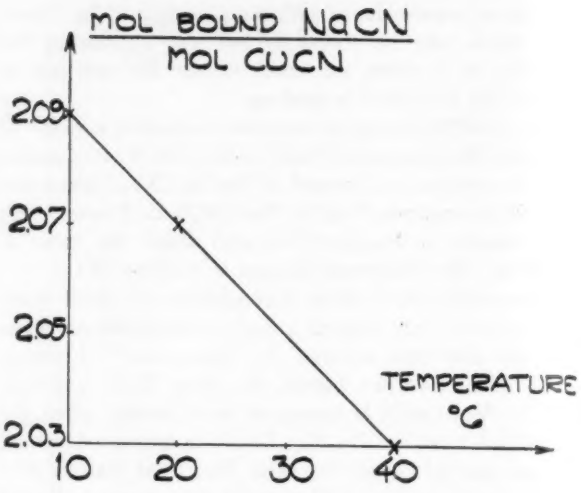

Figure 5

Ratio $\frac{\text{Mol combined NaCN}}{\text{Mol CuCN}}$ as a function of temperature.

Summary

1. The different types of solid alkali cuprous cyanides have been described, with special reference to the electroplating field.

2. A review of the investigations on the composition of the complex ions formed when cuprous cyanide is dissolved in alkali cyanide solutions has been carried out. It is found that, in electroplating solutions, the chief metal-bearing ion is $Cu(CN)_3^{=}$, although, dependent on prevailing conditions, the ions $Cu(CN)_2^{-}$ and, to a minor degree, $Cu(CN)_4^{\equiv}$ are also present.

3. The free cyanide content has been determined, when changing the concentrations of the components, pH and temperature of the solutions. From this, conclusions can be drawn regarding the behavior of the complex ions. The following results were obtained:

a) addition of alkali cyanide tends to cause a shift toward a higher coordination number.

b) addition of cuprous cyanide decreases the free cyanide content and tends to lower the coordination number.

c) dilution of solutions containing complex copper cyanide ions increases the free cyanide content, i.e. the higher complex ions dissociate partly.

d) at higher pH the free cyanide content is increased, i.e. the higher complex ions dissociate partly.

e) at higher temperature the free cyanide content is increased, i.e. the higher complex ions are partly split up.

However, it must be concluded that most of the copper in electroplating baths is bound as the complex ion $Cu(CN)_3^{=}$, which means that 1 mol cuprous cyanide combines with 2 mols potassium cyanide or sodium cyanide respectively. In order to combine 1 gram of cuprous cyanide, it therefore requires 1.45 grams of potassium cyanide or 1.10 grams of sodium cyanide. This is approximately valid for all cyanide copper-plating baths.

(*References appear on page* 75)

Surface Preparation by Blast Cleaning Prior to Electroplating

By Victor F. Stine, *Vice President, Pangborn Corporation, Hagerstown, Md.*

PREPAIRING surfaces of metals, plastics and other materials before electroplating is intended to: (1) achieve physical, mechanical and chemical cleanliness, (2) remove projections, such as burrs, or sharp edges and feather edges left by grinding or polishing, (3) remove, blend and smooth tool and grinding lines or scratches, and (4) provide an optimum bonding surface to produce sound, tight adhering plate.

This surface preparation must usually be done without loss of tolerances, distortion of the piece, adverse effect on ultimate appearance, or harm to the protective effects of the coating to be applied. Naturally, it is desired to achieve these ends as economically, as safely, and under as pleasant working conditions as possible.

The process of impact blast cleaning is one whereby abrasives are propelled at the surface to be cleaned by air or by centrifugal force. Thousands of abrasive particles strike the surfaces to be cleaned with a high velocity stream, producing an effect that may combine both a cleaning and a finishing action.

Effect of the abrasive stream may be varied by controlling such mechanical factors as hardness of the abrasive, abrasive particle size, velocity of the work, method of application, and work flow. Each of these variable factors will be discussed in detail under separate appropriate sections.

What Impact Blasting Can and Cannot Do

Impact blasting, as it is applied to preparation of surfaces prior to finishing, is generally used to replace pickling, electrochemical cleaning and hand finishing. Ordinarily, no other cleaning is necessary on pieces that are blasted. No alkali cleaning is necessary because the blasted surface is chemically and mechanically clean. An exception is those parts which have a heavy coat of grease. In that case degreasing is advisable.

In addition, it finds use: (1) to produce a "tooth" for better bonding of electrodeposits, (2) to improve bonding of rubber, paint, plastics and other coatings to metal surfaces, and (3) to produce a decorative two-toned effect which is applied by means of stencils or masking tape and which may serve as a final non-glare finish for sections of the part.

In replacing, or reducing hand finishing, impact blasting is generally adaptable to the following uses:

1. *Removing and blending directional grinding lines.* By blasting, the microinch finish may be considerably improved, particularly in intricate sections on surfaces usually cleaned haphazardly. Actually, the matte finish produced is often smoother than the mirror finish attained by finish grinding. However, when blasting is used prior to decorative plating, intermediate buffing and polishing operations may be necessary. Even when bright polishing follows blasting, final polishing may require from 25 to 75 per cent of the time normally required for hand cleaning alone.

2. *Producing a "tooth" for better bonding.* It is estimated that the surface area of metal increases as much as 10 times as the result of the abrasive's impact action. This increases the surface to which the electroplated or painted coating can adhere.

3. *Removal of fillets, feather edges and metal fuzz left by grinding or polishing.* In many cases, if plating is applied without first blasting the part, the coating will adhere to the feather edges. Under operating conditions the feather edges tend to shear and leave the coating unattached in that area. Peeling is then likely to result.

4. *Removal of heat treat scale.* Removal of heat treat scale, which requires hours by hand methods, may be removed in minutes by blasting. Only a light polishing operation is required to restore luster, if desired. With high carbon steel and cast iron it is possible to remove all surface impurities by blasting without danger of hydrogen embrittlement.

5. *Removal of burrs.* Blasting offers a method of removing small burrs from accurately machined parts, particularly from internal passages. Feather burrs of approximately 0.0002-3" can be sheared easily, but actual removal of "chunks" of metal is not practical. Burrs are easier to remove from hardened metal since they are not so likely to roll under.

Blasting can give different types of finish on the same article by the use of stencils or masking tape. By the same means, it is possible to maintain sharp edges and points on one section while burrs are being removed from another.

Blasting is considered economical. Cost of original equipment is adaptable to the type and amount of cleaning and finishing required. Model changes in style and shape of the parts to be cleaned do not generally require new blasting equipment, methods or personnel

training. The abrasives are relatively inexpensive and reusable.

In summary, the general economic advantages of blasting lie in the reduction of man-hours required to clean and finish parts, the need for only relatively trained personnel, and the high productivity per hour per dollar of equipment.

On the other hand, it must be remembered that the finish obtained by blasting is a function of the finish before blasting. Blasting will not make a rough ground piece as smooth as a finished ground piece. Blasting can make a good finish better and cleaner, but it can do little to improve a pitted, uneven surface. Blasting cannot always repair rejects from a previous operation.

It should be remembered also that blasting is not a tool for producing a given dimension. In other words, a part should be finished to dimensions before blasting, and then blasted with abrasives, pressures, angle of impact, etc., to hold that dimension. For example, a sharp edge may be rounded by blasting and the ruggedness may be removed, but the radius of the edge is not changed.

The general methods by which abrasive is applied, or propelled, against work to be cleaned or finished may be classified into two major classes:

1. Air pressure blasting.
2. Airless (centrifugal) blasting.

Air Pressure Blasting

There are two major principles used in air pressure blasting, the direct pressure type and the induction types, the latter based both on the gravity principle and the suction principle.

Direct Pressure Type

In this type of unit (Figure 1) the abrasive is contained in a pressure vessel and forced to the blast gun by compressed air, usually at 80 to 90 psi. In applying the direct pressure principle, the full pressure of compressed air is carried all the way to the tip of the nozzle. Abrasive is introduced into this high pressure line through an orifice in the bottom of the tank, through which it is permitted to flow by gravity (the pressure in the tank and line being equal). In actual practice, the apparatus often is more complicated because of the introduction of adjustable orifices, shut-off means for the abrasive and air, and double chamber arrangements for obtaining continuous operation.

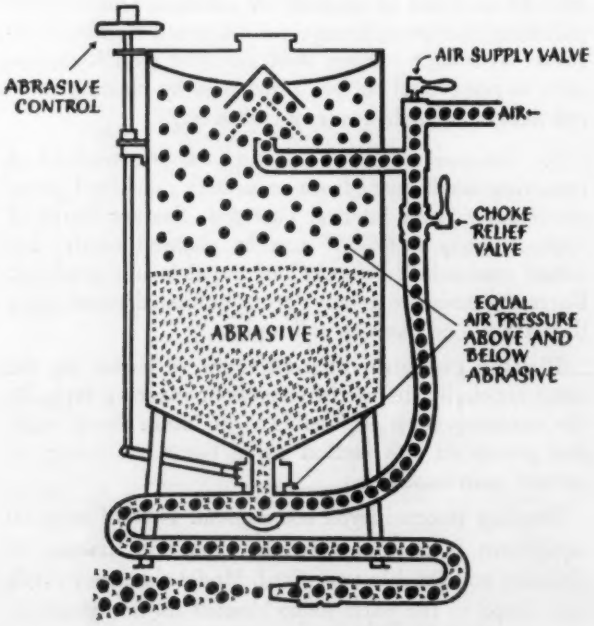

Figure 1. Direct Pressure Type Blasting.

Induction Type

In these units the abrasive is brought to the gun by a partial vacuum created by the compressed air passing through the gun (Figure 2).

The gravity method of induction air pressure blasting provides an overhead, or other means of, abrasive storage which supplies abrasive to an induction type gun, into which air is introduced through a jet which is in a definite spaced relationship to a nozzle. The air rushing from the jet into the nozzle creates a partial vacuum in the space surrounding the gap between jet and nozzle. The abrasive introduced into this gap is sucked into the nozzle and there mixed with the compressed air, which accelerates the movement of each grain. At the nozzle tip, the air suddenly expands, pressure is transformed into velocity, and the grains receive added impetus. This principle, while not as effective as the direct pressure blast, is nevertheless frequently used owing, mainly, to its lower initial and maintenance costs.

The suction method of induction air pressure blasting is similar to the gravity method. While somewhat less effective than the latter, it finds even more application particularly for surfaces which are easily cleaned or which will not withstand the more severe action and intensity of direct pressure blasting. The blasting unit is again a gun, trigger controlled, into which are introduced an air jet and an abrasive nozzle in a definitely spaced relationship. However, contrary to the open hopper or funnel type of mixing chamber used in the gravity type outfit, an outlet is provided at some point for attaching an abrasive hose or pipe line which leads to an abrasive feeding device, often many feet away. When the air is turned on, a partial vacuum is produced within the gun which creates a strong suction in the abrasive line sufficient to lift the abrasive entering the end of the hose or line for considerable distances. To lift this abrasive, energy is required which is lost for useful work. In addition, some expansion takes place in the gun and nozzle which lowers the air velocity, and thus reduces intensity of the blast. These reasons account for the fact that this suction principle is the least effective of the three, and why it is popular for delicate or easily cleaned work.

Airless (Centrifugal) Blasting

The centrifugal method of abrasive propulsion, in which no compressed air is used, has recently come into wide use. Abrasive is fed to a rapidly rotating vaned wheel, with normal speeds from 2200 to 3000 rpm. The abrasive is thrown from this wheel by centrifugal force toward the surface to be treated (Figure 3). Directional control of the stream is secured by varying the point at which the abrasive is fed to the vanes. This process is limited to metal abrasive because the specific gravity of sand is too low for the cen-

trifugal force to do as efficient cleaning as is possible with the much heavier metal abrasives. An airless blast cleaning unit consists of four integral parts: (1) the abrasive feeding mechanism, (2) the vaned wheel which supplies the final velocity to the abrasive, (3) the drive assembly, and (4) the wheel housing.

The abrasive is fed through a stationary spout into a cup which is attached to, and rotates with, the wheel, or rotor. The first abrasive to enter the cup is formed into a hollow cone by centrifugal force. Subsequent abrasives slides over this conical surface to reach the cup rim. A deflector starts the flow of, and guides abrasive to the vaned wheel. The deflector is adjustable angularly, and it is this device which controls the abrasive's path. The vaned wheel is of open side type, with removable vanes along which the abrasive is impelled toward its target. Wheels operate clockwise or counterclockwise, according to the work for which they may be designed. A velocity of 240-250 ft. per sec. at the wheel edge is generally accepted. The rotor drive is usually a conventional five strand V-belt type.

Suspended Media Blasting

Application of abrasives in dry form has been considered to this point. Of great interest to those concerned with the preparation of surfaces prior to electroplating is liquid impact blasting. In this modified form of blasting (Fig. 4), an abrasive is suspended in a liquid which is delivered to the blasting nozzle by means of a circulating pump. At present, most liquid blasting uses the suction feed method (described above), or a modification of this method in which the abrasive is fed to the blast gun at low pressure.

Since abrasive is suspended in a liquid (usually water plus a corrosion inhibitor), there is no limit to the fineness of particles that can be used. Generally they are in the talcum powder range and finer; as coarse as 60 mesh and as fine as 5000 mesh equivalent. Only nonmetallic abrasives can be used.

Equipment used for liquid blast cleaning includes a water tight cabinet where work is cleaned, a hopper tank for mixing, storing and recollecting the suspension, a circulating pump, and a blasting gun equipped with two lengths of flexible hose, one for abrasive feed and one for air supply.

After liquid blasting, parts are usually dipped into a rinse tank containing clear water plus corrosion inhibitor. When rapid drying of parts is desired, the solution should be kept warm (140°F.). A good alternate system is to use compressed air to blow off excess water after rinsing.

Liquid blasting is a flexible process because there are a number of factors which may be varied. These are: (1) particle size and hardness of the abrasive, (2) air pressure, (3) distance from gun to work, and (4) liquid to abrasive ratio.

The process is considered economical. Abrasives, even in the finer ranges, are relatively inexpensive and have a useful life of 25 to 40 operating hours. Also, life of pump and nozzle parts is relatively long since the flow of abrasive suspended in liquid has little tendency to erode metal.

Liquid blasting has been termed the "finish grinder" of the blasting field. It is primarily used for processing finished material and not raw material. With extremely

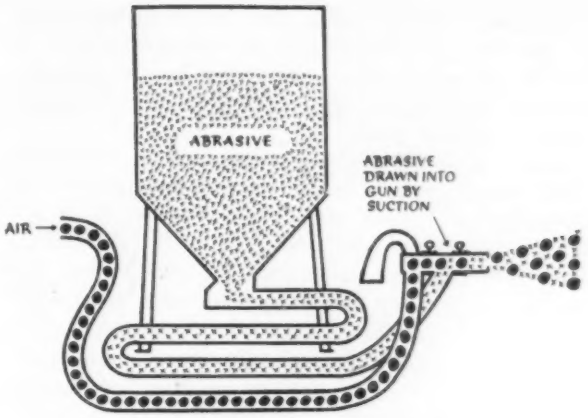

Figure 2. Induction Type Blasting.

fine mesh abrasives it is possible to process precision machined parts and hold within tolerances of 0.0001" where required. The most commonly used abrasive is a siliceous rock found in Arkansas in a natural decomposed state. It is available in a prepared condition ready for use in mesh sizes of 100 to 5000 from several manufacturers.

The great versatility of liquid blasting is clearly indicated by some typical solutions of the process with an indication of what is accomplished at considerable savings in man hours.

Liquid impact blasting offers a method for removing small burrs from accurately machined parts where hand deburring is slow and tedious. The process also removes burrs from internal passages and from very small diameter holes where the ordinary dry processes will not carry.

Many hours are spent each day by tool and die shop machinists in removing heat treat scale from dies and in polishing them. A fairly simple small cavity may require as long as 6 or 8 man-hours to polish. Liquid blasting can accomplish this same job in 3 or 4 min. After the scale is removed, only a light polishing operation is necessary to restore luster.

In many cases hard chromium plating is greatly improved by liquid blast cleaning the surface of the part to be plated before chromium is applied. This finishing produces an increased amount of surface to which the chromium can adhere and, at the same time, produces a "tooth" for better bonding. Liquid blasting after plating produces oil storage wells which makes lubricating of this surface more easily controlled. In cases where chromium plating of die parts has heretofore been unsatisfactory, the addition of a liquid blasting operation before plating has shown a definite improvement in the adhesion of the chromium. Decorative plating having a two-toned effect may be applied by means of stencils or masking tape.

Liquid blasting also has been used for improving bonding of rubber, paint, plastic and other coatings to metal surfaces. Blasting improves bonding in these cases in much the same way as mentioned previously. It has also been used successfully for removing the wire edge left around engraved letters on plastic molding dies. In dies used for making electrical switch parts and in many other cases this lettering is quite small and difficult to polish. Liquid blasting is a satisfactory method of polishing these letters without distorting

them. Liquid blasting also offers an excellent method of removing grinding lines from intricate sections of the die. Some types of plastic dies require periodic cleaning, and liquid blasting plays an important part in finishing this work.

Liquid blast cleaning also can be used on die casting dies. New dies can be treated in much the same way as the plastic dies mentioned above. However, it is not necessary to polish the satin finish left by blasting. This finish is most satisfactory for die casting. Die casting dies require periodic maintenance due to the formation of carbon deposits on the die parts.

In forge shops liquid blasting equipment can be used to remove, blend and smooth the grinding lines on the die surface and provide for a smoother flow of metal. The use of liquid blasting for forming and deep drawing dies has also been successful. By removing the grinding lines, as mentioned before, the tendency for the die to gall and score is greatly reduced and the drawn metal shows less drawing marks. Liquid blasting the die surface also causes a better distribution of drawing compound. Other types of dies that are frequently processed by this method are heading dies and punches, extrusion dies, swaging dies, and many other types of special dies.

Liquid blast cleaning is useful for producing a decorative finish, and in many cases can be substituted for more costly buffing operations. This finish has been used on calibrated dial and veneers to prevent glare and increase readability of calibrations.

The process has also proved helpful in improving cutting tool life by removing grinding lines and feather edges from the cutting faces of the tool. At the same time it produces a satin finished tool. Due to the highly stressed nature of many machine parts, the presence of directional grinding lines provides a source for fatigue failures. Liquid blasting can in many cases remove all traces of these lines, and in other cases blend them in such a manner as to reduce the possibility of fatigue failure.

Liquid blasting can be used to advantage for finishing threads where a smooth, close fit and easy turning is required. The process also has many possibilities for use in improving lubrication. The impact of the abrasive produces tiny indentations which serve as minute oil storage wells.

Finally, liquid blasting has a wide variety of maintenance cleaning applications. It has been used for engine overhaul work, for cleaning ordinance items, and for cleaning steam turbine blades.

Abrasives and Pressures

Almost any finish can be obtained by using the proper abrasive, or combination of abrasives, or by adjusting the air pressure.

Metal abrasive is available in shot (round) particles, and in grit (angular) particles. Metal shot abrasive is intended for work that can be cleaned by shock. It works like numerous ball peen hammers. In cleaning rough work it may provide an attractive surface finish

DIAMETER OF NOZZLE INCHES	AIR — PRESSURE AT GAUGE IN POUNDS PER SQUARE INCH — HP								
	20	30	40	50	60	70	80	90	100
1/8	7.70 .73	10. 1.03	12.30 1.50	14.50 1.99	16.80 2.57	19. 3.19	21.20 3.80	23.50 4.51	25.73 5.33
5/32	12.04 .99	15.72 1.62	19.17 2.34	22.68 3.11	26.22 4.01	29.71 4.99	33.20 6.04	36.44 7.00	42.50 8.80
3/16	17.10 1.40	22.50 2.32	27.50 3.26	32.80 4.49	37.50 5.74	43. 7.24	47.50 8.65	52.50 10.08	57.88 11.98
7/32	23.77 1.95	30.81 3.17	37.58 4.58	44.44 6.09	51.37 7.86	58.24 9.78	65.08 11.84	71.43 13.71	78.80 16.31
1/4	30.80 2.53	40. 4.12	49.10 5.99	58.20 7.97	67. 10.25	76. 12.77	85. 15.47	94. 18.05	103. 21.37
9/32	39.02 3.20	50.94 5.25	62.13 7.58	73.47 10.07	85. 13.00	96. 16.13	108. 19.66	118. 22.66	130. 26.91
5/16	48.17 3.95	62.89 6.48	76.70 9.36	90.70 12.43	105. 16.07	119. 20.00	133. 24.10	146. 28.03	161. 33.32
11/32	58.29 4.75	75.10 7.74	92.81 11.32	109.85 15.05	127. 19.43	144. 24.19	161. 29.30	176. 33.99	195. 40.17
3/8	69. 5.66	90. 9.27	110. 13.42	130. 17.81	151. 23.10	171. 28.73	191. 34.76	211. 40.51	232. 47.90
13/32	81. 6.64	106. 10.92	130. 15.86	153. 20.96	178. 27.23	201. 33.77	225. 40.95	246. 47.23	272. 56.30
7/16	94. 7.71	123. 12.67	150. 18.30	178. 24.39	206. 31.53	233. 39.14	260. 47.37	286. 54.91	315. 65.11
15/32	108. 8.86	142. 14.63	173. 21.11	204. 27.98	236. 36.11	268. 45.02	299. 54.42	328. 62.95	362. 74.93
1/2	123. 10.09	161. 16.58	196. 23.91	232. 31.78	268. 41.00	304. 51.07	340. 61.88	376. 72.19	412. 85.28
9/16	156 12.79	204. 21.01	249. 30.38	294. 40.28	340. 52.02	385. 64.68	430. 78.26	472. 90.52	521. 107.85
5/8	193. 15.83	252. 25.96	307. 37.45	364. 49.87	420. 64.16	476. 79.97	532. 96.81	587. 112.10	643. 133.10
11/16	233. 19.11	304. 31.31	371. 45.26	439. 60.14	508. 77.72	575. 96.60	643. 117.03	706. 135.55	778. 161.05
3/4	277. 22.91	362. 37.79	442. 54.18	522. 71.51	604. 92.41	685. 115.08	765. 139.23	843. 161.86	925. 191.48
7/8	378. 31.00	493. 50.78	601. 73.32	710. 97.27	822. 125.77	930. 156.36	1004. 182.73	1145. 219.64	1261. 261.03
1	494. 40.81	645. 66.43	785. 95.77	930. 127.41	1070. 163.71	1215. 204.12	1360. 247.32	1500. 288.00	1647. 340.93

Air flow, with required H. P. to develop, through direct pressure nozzles and suction and gravity air jets of various internal diameters.

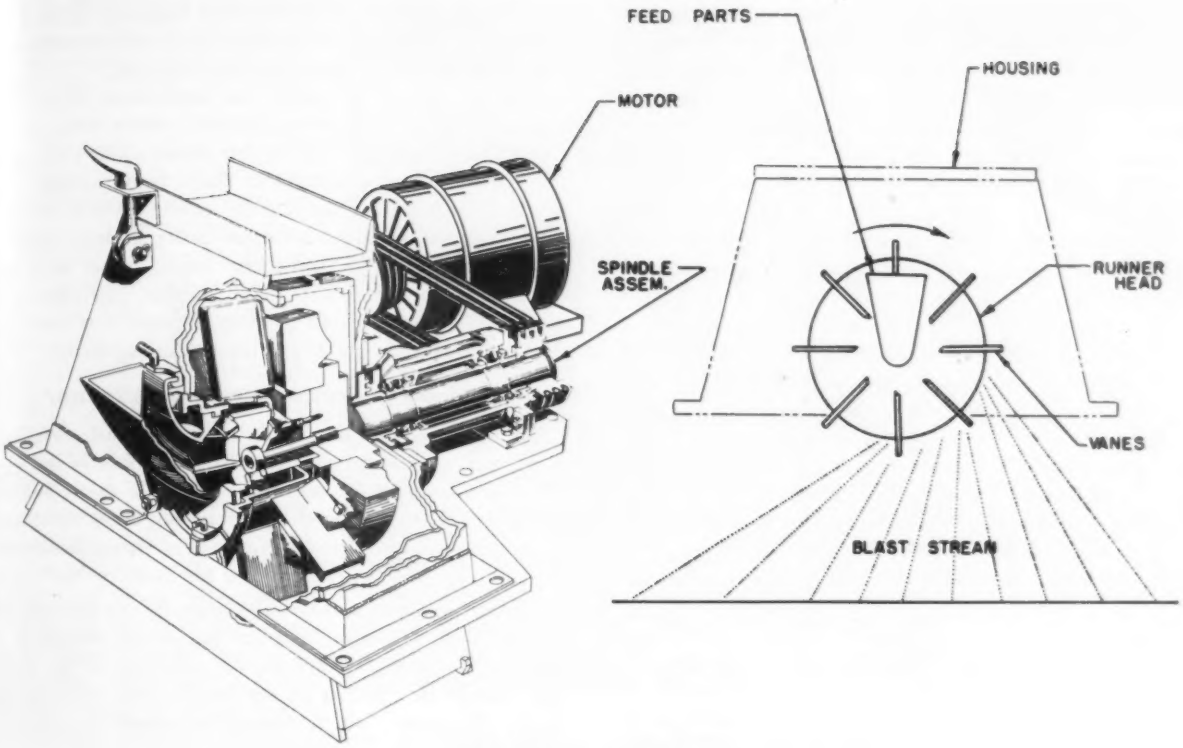

Figure 3. Centrifugal Blasting.

but, in general, its action leaves too indented a surface for plating. Metal grit abrasive acts like thousands of minute cutting tools, giving an open structure and matte finish. The surface is scoured of impurities, leaving a clean base for many different kinds of finishes. Both shot and grit are available in standard SAE numbers.

Not only abrasives, but also the pressure under which they are hurled at a surface effects the finish of a part being cleaned. For ferrous metals, the pressure ranges from 60 up to 100 psi. depending on the degree of cleaning required and condition of the work. For non-ferrous metals the pressure is from 10-60 psi, also depending on the nature of the work and degree of cleaning. On blast work for design or frosting effect, the air pressure is usually from 3-15 psi.

Cabinets, Barrels and Tables

There are various types of impact blast cleaning equipment available in which blasting is carried on. Proper selection depends upon the nature and volume of work to be cleaned. The types of interest to those preparing surfaces prior to electroplating may be classified as cabinets, barrels and tables.

Blast Cleaning Cabinets are available in many types and sizes, for one or two operators. Two popular sizes are: 30 x 12 inches maximum size of work, and 31 x 22 inches maximum size of work. Controls in the smaller machine consist of a push and pull rod in the interior of the cabinet; the larger machine is operated by a treadle. Cabinets have vision windows, loading doors, air control valves, suction type abrasive feed, and a ventilating system to remove the dust or fog (in case of suspended media blasting) created by the blasting.

The operator works from the outside of the cabinet and places his arms through rubber gauntlet-covered armholes. Work to be finished is held in one hand, or rested on a work table while the other directs the blast stream.

Obviously, blast cleaning cabinets are suitable for smaller plants, for low production requirements, and for cleaning of occasional parts.

Blast Cleaning Barrels differ from the equipment

Figure 4. Imperial Brass Mfg. Co., Chicago, Ill., uses liquid blast cleaning to remove heat treat scale and carbon deposits from forging and casting dies, saving $75 per day on cleaning costs.

them. Liquid blasting also offers an excellent method of removing grinding lines from intricate sections of the die. Some types of plastic dies require periodic cleaning, and liquid blasting plays an important part in finishing this work.

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7/32	23.77 1.95	30.81 3.17	37.58 4.58	44.44 6.09	51.37 7.86	58.24 9.78	65.08 11.84	71.43 13.71	78.80 16.31
1/4	30.80 2.53	40. 4.12	49.10 5.99	58.20 7.97	67. 10.25	76. 12.77	85. 15.47	94. 18.05	103. 21.52
9/32	39.02 3.20	50.94 5.25	62.13 7.58	73.47 10.07	85. 13.00	96. 16.13	108. 19.66	118. 22.86	130. 26.91
5/16	48.17 3.95	62.89 6.45	76.70 9.36	90.70 12.43	105. 16.07	119. 20.00	133. 24.10	146. 28.03	161. 33.32
11/32	58.29 4.75	75.10 7.74	92.81 11.32	109.85 15.05	127. 19.43	144. 24.19	161. 29.30	176. 33.79	195. 40.37
3/8	69. 5.66	90. 9.27	110. 13.52	130. 17.81	151. 23.10	171. 28.73	191. 34.76	211. 40.51	232. 47.90
13/32	81. 6.64	106. 10.92	130. 15.86	153. 20.96	178. 27.23	201. 33.77	225. 40.95	246. 47.24	272. 56.30
7/16	94. 7.71	123. 12.67	150. 18.30	178. 24.39	206. 31.52	233. 39.14	260. 47.37	286. 54.91	315. 65.21
15/32	108. 8.86	142. 14.63	173. 21.11	204. 27.95	236. 36.11	268. 45.07	299. 54.52	328. 62.95	362. 74.93
1/2	123. 10.09	161. 16.58	196. 23.91	232. 31.78	268. 41.00	304. 51.07	340. 61.88	376. 72.19	412. 85.29
9/16	156 12.79	204. 21.01	249. 30.38	294. 40.28	340. 52.02	385. 64.68	430. 78.76	472. 90.52	521. 107.85
5/8	193. 15.83	252. 25.96	307. 37.45	364. 49.87	420. 64.26	476. 79.97	532. 96.82	587. 112.70	643. 133.10
11/16	233. 19.11	304. 31.31	371. 45.26	439. 60.14	508. 77.72	575. 96.60	643. 117.03	706. 135.55	778. 161.05
3/4	277. 22.91	362. 37.79	442. 54.48	522. 71.51	604. 92.41	685. 115.08	765. 139.23	843. 161.86	925. 191.48
7/8	378. 31.00	493. 50.78	601. 73.32	710. 97.27	822. 125.77	930. 156.56	1004. 182.73	1145. 219.64	1261. 261.03
1	494. 40.51	645. 66.44	785. 95.77	930. 127.41	1070. 165.71	1215. 204.12	1360. 247.92	1500. 288.00	1647. 340.93

Air flow, with required H. P. to develop, through direct pressure nozzles and suction and gravity air jets of various internal diameters.

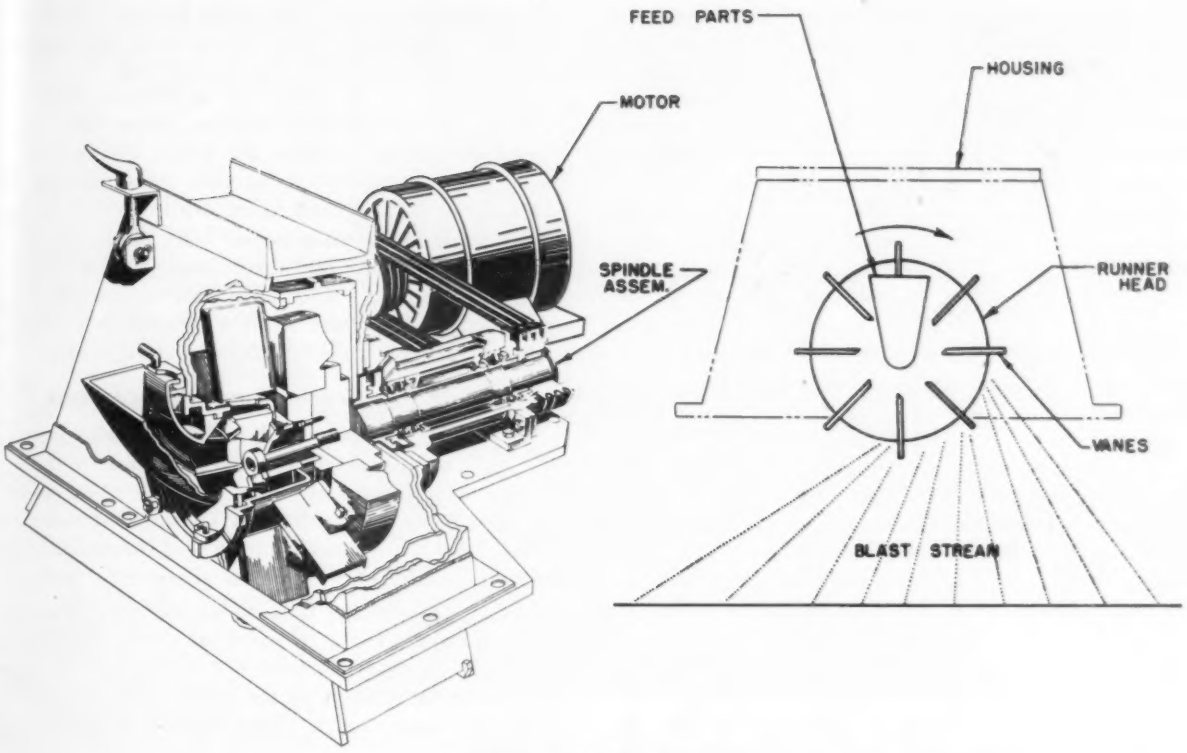

Figure 3. Centrifugal Blasting.

but, in general, its action leaves too indented a surface for plating. Metal grit abrasive acts like thousands of minute cutting tools, giving an open structure and matte finish. The surface is scoured of impurities, leaving a clean base for many different kinds of finishes. Both shot and grit are available in standard SAE numbers.

Not only abrasives, but also the pressure under which they are hurled at a surface effects the finish of a part being cleaned. For ferrous metals, the pressure ranges from 60 up to 100 psi. depending on the degree of cleaning required and condition of the work. For non-ferrous metals the pressure is from 10-60 psi, also depending on the nature of the work and degree of cleaning. On blast work for design or frosting effect, the air pressure is usually from 3-15 psi.

Cabinets, Barrels and Tables

There are various types of impact blast cleaning equipment available in which blasting is carried on. Proper selection depends upon the nature and volume of work to be cleaned. The types of interest to those preparing surfaces prior to electroplating may be classified as cabinets, barrels and tables.

Blast Cleaning Cabinets are available in many types and sizes, for one or two operators. Two popular sizes are: 30 x 12 inches maximum size of work, and 31 x 22 inches maximum size of work. Controls in the smaller machine consist of a push and pull rod in the interior of the cabinet; the larger machine is operated by a treadle. Cabinets have vision windows, loading doors, air control valves, suction type abrasive feed, and a ventilating system to remove the dust or fog (in case of suspended media blasting) created by the blasting.

The operator works from the outside of the cabinet and places his arms through rubber gauntlet-covered armholes. Work to be finished is held in one hand, or rested on a work table while the other directs the blast stream.

Obviously, blast cleaning cabinets are suitable for smaller plants, for low production requirements, and for cleaning of occasional parts.

Blast Cleaning Barrels differ from the equipment

Figure 4. Imperial Brass Mfg. Co., Chicago, Ill., uses liquid blast cleaning to remove heat treat scale and carbon deposits from forging and casting dies, saving $75 per day on cleaning costs.

used in abrasive tumble finishing. In the latter, parts to be cleaned and abrasives are placed in a barrel together and slowly turned. Rubbing action of the abrasive on the parts cleans and polishes. Blast cleaning barrels, on the other hand, contain no abrasive, but act only as a carrier to roll and turn the parts so that all surfaces are exposed to a stationary blast gun (Fig. 5). Barrel speeds range from 1.5 rpm in the 250 pound maximum load size to 2.8 rpm in the smaller 150 pound size. Both of these types are used for limited batch production or for auxiliary use with larger equipment.

Continuous barrel blast cleaning, as opposed to the batch processes of the simple barrels and rocker barrels, has become available to handle a continuous flow of work coming from preceding operations. These machines range in capacity from 3 to 18 cu. ft., and have found application in cleaning castings from shakeout, forgings from heat treatment and stampings from presses. The principle of continuous flow barrel blast cleaning may well be considered, however, by electroplaters with a large, steady volume of cleaning to handle.

Blast Cleaning Tables are perhaps the most versatile of all equipment. On tables (Fig. 6) it is possible to clean fragile parts for which no other general type of equipment is suitable, since there is no tumbling to chip corners or break thin parts. In addition, tables accept work as it comes, cleaning speeds can be varied, no time is lost loading or unloading, and it is possible for unskilled labor to produce a thoroughly cleaned, silvery bright surface texture for enamelling, plating, metallizing, and sherardizing.

In its simplest form, a table consists of a horizontal platform suspended on a center shaft and driven by a tire at its rim. The platform rotates partly exposed, and partly within the steel housing that confines the blast action. Work is laid on the table in the exposed area while it rotates. Work then passes into the blasting zone. When it reappears it is turned as necessary for additional cleaning, or removed as finished. Three dust barriers, consisting of flexible split rubber curtains, are between the operator and the blasting.

Various types of tables are available. Some are equipped wtih air pressure nozzles, others with airless (centrifugal) units. Tables are made also with auxiliary work tables which, as they pass through the blast stream on the main table orbit, revolve around their own independent axes and bring both horizontal and vertical surfaces into direct impingement with the blast stream. Work with deep pockets, intricate contours and multisurfaces is often cleaned best on auxiliary revolving spindle type blast cleaning tables.

Operating Practices and Suggestions

In air blast cleaning and in liquid blast cleaning, the small, comparatively inexpensive nozzle is the key component affecting cleaning costs. It controls the amount of energy which must be supplied from the compressor. It governs cleaning speed through the efficiency with which it discharges abrasive to the work.

Nozzle effieiency, of course, depends on distance of nozzle from the work. In addition, nozzle efficiency is affected by these two factors: (1) selection of the right size nozzle in relation to air power and work to be done, (2) wear, which causes the nozzle to become inefficient.

While the type of work has a bearing on the size of nozzle to be used, it is axiomatic that the nozzle orifice should be kept as small as possible with relation to the work. The size of the nozzle orifice in direct pressure blast cleaning and the size of the opening in suction or gravity feed equipment govern the air flow. Compression of air requires expensive power — the larger the orifice, the greater the air flow, and consequently, more power is needed to supply the pressure (see table). And air flow (with proportionate flow of abrasive) controls cleaning speed.

Length of the nozzle is important — a longer nozzle producing a more concentrated stream, whereas a short nozzle covers a larger area but shows a slightly lower abrasive velocity. It is well to note here that in suction or gravity blast cleaning, discharge nozzles and air jets must always be used in the relation of approximately 2 for 1, the discharge nozzle having about twice the internal diameter of the air jet.

Nozzles are subject to wear. As both air and abrasive pass through, direct pressure equipment wears internally in the shape of a cone from the inlet through the entire length of the nozzle, causing the abrasive stream to spread. This spread may sometimes be as much as

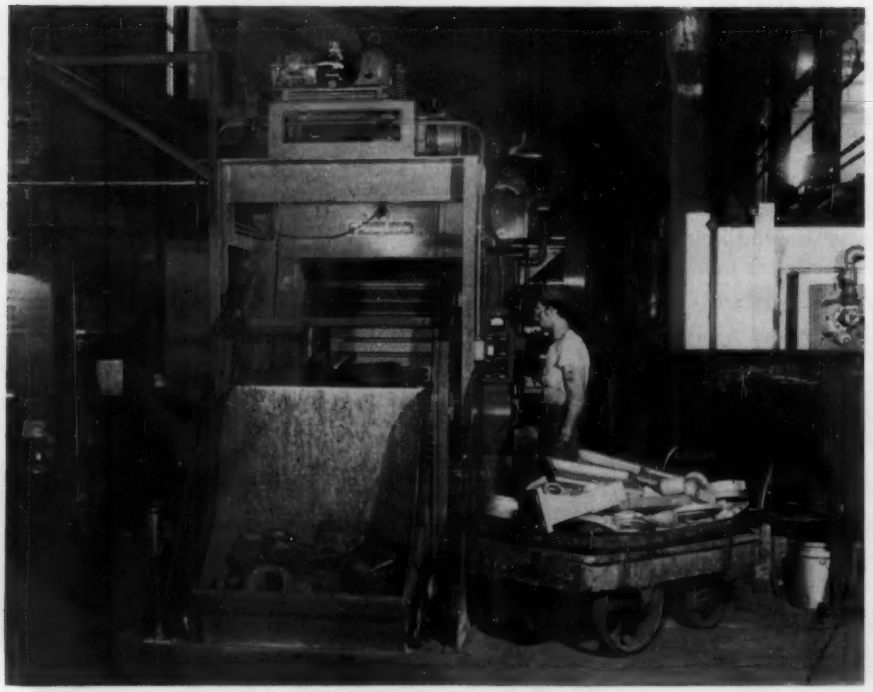

Figure 5. Blast cleaning barrel in operation. Castings to be cleaned are loaded into the machine by means of push-button controlled work loader.

Figure 6. An eight foot diameter blast cleaning table used to clean multi-surfaced welded steel heating coils at Vapor Heating Co., Chicago, Ill.

four times that of a new nozzle. Suction or gravity fed equipment does not wear in the internal diameter, since air only passes through the air jet. Wear comes on the discharge nozzle through which the combined air and abrasive are discharged.

The effect of wear is easily illustrated. A new $\frac{3}{8}$ in. nozzle, for instance, permits flow at 90 lb. pressure of about 211 cu. ft. of free air, requiring 40.5 hp. for its production. If permitted to wear at the inlet to $\frac{7}{16}$ in., air flow increases to 286 cu. ft. or 35½ per cent, and the power to 54.9 (also 35½ per cent). It is therefore readily seen that it may prove to be bad economy to use a nozzle too long, particularly in equipment using multiple nozzles.

Lighter abrasives will wear a nozzle faster than heavier abrasives. Each moving abrasive particle has a certain kinetic energy, which is directly proportional to its weight or mass. If it were possible to fire from a double barrel gun during a windstorm a cork ball and a lead ball simultaneously, the cork ball would be deflected from its course much more rapidly than the lead ball. Similarly, side thrust exerted by the expending air acts more quickly on the lighter grains than on the heavier ones, tending to force them against the nozzle walls.

Another reason for rapid wear on nozzles caused by lighter abrasives such as sand or artificial abrasives, is the fact that they travel through the nozzle faster than the heavier steel abrasives, since it is easier for compressed air to accelerate a light particle than a heavier one. This higher velocity causes a larger volume of abrasive to flow in a given time, resulting in more frictional wear.

It goes without saying that granular abrasives (meaning grains which have sharp corners) cause more nozzle wear than globular grains. In suspended media blasting, abrasive is suspended in a liquid. Consequently, wear on nozzles is materially reduced, particularly with the organic abrasives. Various nozzle types are available with screw or flange hose connections. Nozzle wear has been reduced by the use of tungsten carbide or boron carbide liners.

Work Handling

Moving materials to and from industry's machines is a vital problem to management today. In many cases this cost is as much as 30 per cent of the manufacturing cost. Modern plants make full use of modern devices for materials movement — overhead rails with specially designed books, roller and slat conveyors, tote boxes and skids moved by trucks, and various combinations of these methods.

In the high-speed mass production world of today it is often necessary to design blast equipment to fit the *part, production rate* and the *material handling system* which precedes and follows the cleaning unit. In more cases than not, standard equipment described above will fill the bill. But occasional situations — and the number is growing as we increase our heavy production — justify engineering ingenuity beyond the standard limits.

To guide the process engineer who wants to convert a bottleneck cleaning operation into a high speed production line — some of the fundamental rules of approach are: (1) never set the part down if it can be avoided; (2) speed up motion between blast stations; (3) turn or oscillate the part before the blast stream so that as many faces and contours as possible may be blasted at each station; (4) consider loading, unloading, and adjacent processes as part of a single integrated system; (5) plan the part transfer system so that any secondary, stray or deflected streams of abrasive strike work rather than fixtures or chamber walls; (6) consider worker-fatigue and the operator's motions in loading and unloading (eliminating manual handling where possible and simplifying motions elsewhere); (7) pay special attention to seals and partitions, to save abrasive and prevent it striking the operator; and (8) think freely with regard to the aiming and orientation of blast streams (oblique, upward, across, downward, or edgewise along narrow work).

Admittedly, it takes a good deal more time and money to adapt a standard machine to special purposes, or to design an entirely special machine, as against making some standard piece of equipment do. But often the investment pays off in terms of: (1) lower cleaning costs; (2) reduced floor space; (3) elimination of costly manual handling and finishing; and (4) more efficient cleaning of the work.

Electroplating on Titanium

By William H. Colner, Morris Feinleib,[1] and John N. Reding,
Armour Research Foundation of Illinois Institute of Technology, Chicago, Illinois

Introduction

TITANIUM has recently emerged from the class of rare metals, and is in the process of becoming an important structural material. Its outstanding properties are a high strength-to-weight ratio and excellent corrosion resistance to a great number of chemicals at room temperature.

The need for electroplating on titanium may arise for several reasons, such as decorative plating, improved resistance to high-temperature gases, improved mechanical properties of the surface, or joining of titanium parts.

Titanium is an extremely active metal. Its high corrosion resistance is due to the fact that the metal becomes covered with an impervious and tightly adherent oxide film. This film, however, makes it very difficult to obtain adherent electrodeposits on the metal. Conditions required to remove the oxide are usually so drastic that the metal reacts violently once the surface film is dissolved; under such conditions it becomes very hard to apply a sound electroplate, or even a strike, to the titanium.

A survey of the literature cast little light on the problem. Some mention was made by Couch and Brenner (1) of obtaining adherent deposits on titanium using a dry lithium hydride, ethyl ether, etc. However, this technique was considered impractical insofar as the present problem is concerned. Conventional methods for plating on common metals were tried on titanium; these met with no success. Such methods include straight pickling in HF, "nickel pickle" (simultaneous cathodic pickling and nickel deposition), or immersion plates (which yield adherent electrodeposits on aluminum or magnesium).

It was apparent that the activity of the titanium surface was so great in aqueous solutions that an oxide-free surface could not be maintained. In order to reduce the reactivity of the titanium metal, yet maintain it oxide-free, nonaqueous solutions were investigated.

Some plate adherence was achieved by subjecting the metal, prior to plating, to a cathodic treatment in a bath whose main constituent was ethylene glycol, and which also contained a zinc salt, HF, and a small amount of water. This will be discussed below.

The most successful approach to the problem of obtaining adherent electrodeposits on titanium was to subject the metal to an anodic etch prior to plating. This procedure is described in detail below.

Experimental

Raw material.—The bulk of the experiments were carried out with commercially pure titanium sheet.[2] Several lots of RC-55 (Rem-Cru) and Ti75-A (Titanium Metals Corporation), 0.025-0.065 in. thick, were used. A few tests were performed with RC-130 B (Rem-Cru) alloy.[2]

Preparation before plating.—Titanium sheet specimens 2.5 in. x 1 in. were used. They were cathodically cleaned (when required) in a solution of 20 g./l. of sodium orthosilicate at 70°C., and rinsed. This was followed by pickling in a solution containing 185 cc./l. of 48 per cent HF and 8.6 cc./l. of 70 per cent HNO_3 until the specimen looked clean, and drying. The metal was next subjected to the anodic etching department.

Plating.—After anodic etching, specimens were rinsed and then given a copper strike at room temperature, without stirring, in the following solution: CuCN, 23 g./l.; NaCN, 34 g./l.; Na_2CO_3, 15 g./l. The current was first brought up to 50 amp./ft.^{2} (5.4 amp./dm.^{2}), then brought back to about 15 amp./ft.^{2} (1.62 amp./dm.^{2}) after a few seconds. Plating was continued for 3 to 5 minutes.

The copper strike, after another rinse, was followed by a copper plate at room temperature, with stirring, from the following bath: 448 g./l. $Cu(BF_4)_2$ [sp. gr. 1.36]; HBF_4 to pH 0.6. Plating was carried on at 50 amp./ft.^{2} (5.4 amp./dm.^{2}) for about 10 minutes in most cases (about 0.0005 in.). For heavy plates (about 0.005 in.), plating time was 40 minutes at 100 amp./ft.^{2} (10.8 amp./dm.^{2}).

Testing.—The mechanical properties of electroplates were tested by scraping them with a knife. If no detachment could be observed, the specimen was clamped in a vise and bent by hammering through a 180° angle. The adherence of the plate in the bent areas was then examined.

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2. RC-55: C—0.05-0.2%; O, N, Fe—few hundredths to few tenths % each; other elements—trace.

Ti75-A (nominal): Fe—0.1%; N—0.02%; O—trace; C—<0.04%; W—<0.08%.

RC-130B (nominal): Mn—4%; Al—4%; O, N, Fe—same as RC-55.

In the later stages of the work, a more severe test was substituted for the bend test. One end of the specimen was again clamped in a vise, and then subjected to repeated flexing, using both a bending and a twisting motion. Again, the plate was examined for detachment. The bend and flex tests were naturally most severe when performed on heavy electroplates.

The final test of adherence was the solderability test (which was most severe on thin electroplates). This test consisted of soldering a copper strip onto the electrodeposit, then pulling off the strip. If the joint broke wholly in the solder, the specimen passed the test. In other cases, portions of the copper plate would be pulled off; the size of these areas was a measure of the quality of the plate.

The Anodic Etch

Under proper conditions, anodic etching prior to plating yielded fully adherent copper electroplates (0.0005-0.005 in. thick), which passed the bending, flexing, and solderability tests. Good results were obtained with commercially pure titanium as well as RC-130 B alloy. Etching was carried out in an essentially nonaqueous bath.

Mechanism

The anodic etch, under the right conditions, leads to a rough surface that provides mechanical keying of the electrodeposits. Fig. 1 to 3 clearly show the pockets and reentrant angles created by anodic etching. The surface roughness of these specimens may be as high as 50 microinches root mean square. Plating on this rough surface takes place with good throwing power, and the pockets appear to be completely filled with the plated metal. At the same time, the electroplate surface becomes increasingly smooth as plating proceeds, until it is almost comparable to that of a metal electrodeposited on a smooth base. Even with 0.0005 in. of copper, a fairly smooth plate surface is obtainable.

The mechanical nature of the bond is best illustrated in Fig. 1 to 3. It is supported by the fact that no substance other than titanium metal was found on the surface of anodically etched specimens by spectrographic and electron diffraction techniques which means that no special chemical compound is formed by this etching. Furthermore, the degree of roughness of the surface bears a definite relationship to the adherence of electrodeposits. Under proper conditions, many etching baths can be operated so as to yield a very smooth, electropolished surface on titanium (Fig. 4); plates on such a smooth surface have never been adherent. With improper current distribution, etching can take place in low current density areas and polishing in high current density areas *on the same specimen*; subsequent electroplating yields adherent deposits in the etched areas only.

Anodizing Conditions

When titanium is made anode in a bath in which it is reactive (e.g., a bath containing HF), several possible reactions may take place:

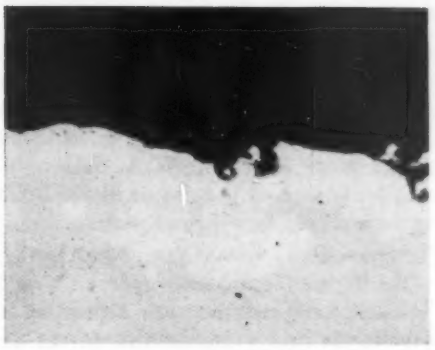

Figure 1. Anodically etched titanium. × 500. Unetched. (In the photomicrographs illustrating this paper, the titanium base metal is the phase in the lower portions. The specimens shown in Fig. 1, 2, and 4 were plated with nickel for metallographic polishing purposes.)

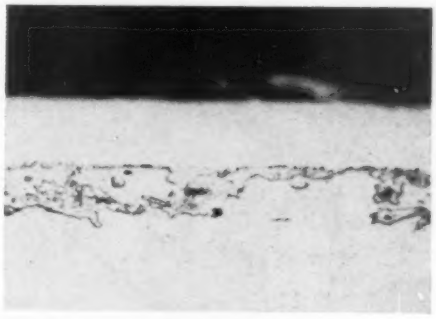

Figure 2. 0.5-mil copper plate on anodically etched titanium. × 500. $H_2O + H_2O_2 + NH_4OH$.

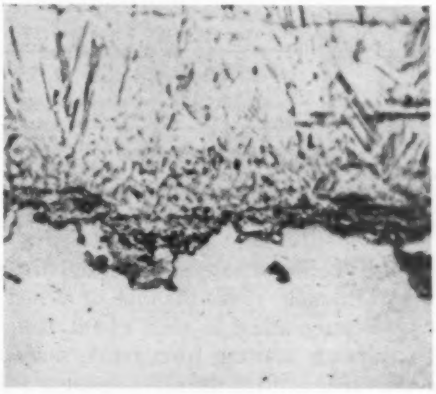

Figure 3. 5-mil copper plate on anodically etched titanium. × 500. $H_2O + H_2O_2 + NH_4OH$.

Figure 4. Electropolished titanium. × 500. Unetched.

1. The current may be insufficient to prevent local (chemical) action, with the evolution of hydrogen. In extremely active baths, it may be altogether impossible to stop this local action at any reasonable current density. The type of surface obtained under such conditions varies from an even, clean, uniformly etched metal to a fairly smooth grayish or blackish film. Such surfaces do not lead to adherent plates.

2. In low activity baths, an anodic treatment may lead to the formation of an impervious oxide film, which is usually colored, the color depending upon the applied voltage. This is comparable to the anodizing of aluminum. The passivated anode offers a high resistance to the passage of current, which drops to a low value. Again, the adherence of electrodeposits on such a base is very poor.

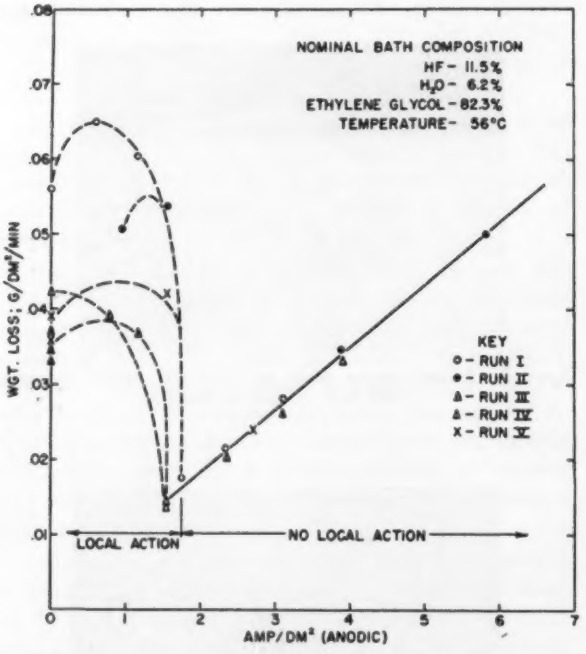

Figure 5. Weight loss of titanium during anodic treatment vs. current density.

3. It is in baths of intermediate activity that the anodizing of titanium yields the type of etched surface desired for electroplating. In such a bath, if increasing current is applied (starting from zero), several effects may be observed. At first, the main result is a decrease in the local chemical action (which takes place with displacement of hydrogen). Until local action has stopped completely, the weight of metal dissolved from the anode per unit time decreases, even though an increasing amount of anodic current is applied. When a certain value of current density has been reached, which varies with bath composition, temperature, etc., the local action is eliminated, and the anodic dissolution of titanium continues without gassing (see Fig. 5). Under such conditions, it is possible to obtain the type of etched surface desirable for electrode deposition, or, by varying operation conditions, an electropolished surface (Fig. 4). The volume of the experimental baths was about 300 cc. During the course of experiments, the composition of the bath was altered slightly by evaporation and hydrogen evolution. As evidenced by the data in Fig. 5, the weight loss per unit time in the range of local action was highly sensitive to the changes in composition. Since the reproducibility in the range of local action was poor the curves connecting the points in that range are merely conjecture, and are drawn with broken lines. In general, with increasing use of the bath, the weight loss in the range of local action decreases. The only effect in the range of no local action with prolonged use of the bath is to decrease the severity of the etch. The apparent valence change of titanium during anodic dissolution was determined from weight loss measurement, on the assumption that the metal dissolves at 100 per cent current efficiency (in the range of no local action). The values found were somewhat in excess of 3, and were slightly higher for electropolishing than for etching. Such determinations are complicated by possible side reactions at the anode, such as the oxidation of Ti^{++} and Ti^{+++} compounds or of hydrogen bubbles.

Operating Variables

A number of solutions with low water content were investigated. Best results were obtained with baths based on ethylene glycol and HF. A typical composition would be the following: 15 per cent by weight HF; 6 per cent H_2O; 79 per cent ethylene glycol. Such a bath should be operated at 55°-60°C., at 50 amp./ft.^{2} (5.4 amp./dm.^{2}), or slightly less. The required etching time is 15 to 30 minutes. When applying current, it is recommended that it be brought up above the desired value (to help stop local action), then brought back to the operating level. Agitation or circulation of the solution is helpful, if not essential. Cathodes may be graphite, copper, nickel, or any other material which is not reactive in the bath. It is preferable to remove the specimen from the bath with the current on, to prevent local action; certainly the work should be withdrawn from the etching solution very rapidly after the current is turned off.

As a general rule, etching conditions are favored by higher temperatures, higher HF content, and lower current densities. Each bath has a useful etching range of temperature and current density. The upper limit of the temperatures would be set by excessive local action, the lower limit by the transition from etching to electropolishing. The lower limit of current density is again determined by the onset of local action (Fig. 5), and the upper limit by electropolishing.

As mentioned before, electrodeposits do not adhere to electropolished surfaces. It is readily seen that the control of current distribution is very important; if the current density is excessive on certain areas, they may become electropolished. Also, if the current density falls below a critical value at certain spots, they are no longer protected against local action, and the adherence of plates is poor at these points.

The useful range of etching current densities is greater at higher temperatures, as well as at higher HF concentrations, as long as local action is prevented.

Bath composition may influence not only the etching range, but also the severeness of the etch. Thus, at increasing water content, the etch may become deeper, but the etching range is reduced in favor of local action, making control more difficult.

It was found that these baths did not deteriorate on

standing; however, some loss in activity was noted with use. Partial rejuvenation was obtained by small additions of HF. Extensive study of these factors was not undertaken.

Fairly good results have been obtained from a wholly inorganic bath based on phosphoric acid: 53.9 per cent by weight H_3PO_4; 12.5 per cent HF; 15.5 per cent NH_4HF_2; 18.1 per cent H_2O. This bath is more active than the one based on ethylene glycol, but more difficult to control. Its useful etching range was 35°-45°C., with current densities of 30-50 amp./ft.^{2} (3.23-5.4 amp./dm.^{2}). This shows that it may be possible to use a number of different solutions for the anodic etching of titanium and its alloys before plating.

Electropolishing

Electropolishing of titanium was a side product of the research on anodic etching for plating.

A solution based on HF and ethylene glycol, but slightly lower in HF than the etching solution, may be recommended for electropolishing, e.g., 6 per cent by weight HF; 6 per cent H_2O; 88 per cent ethylene glycol. This bath should be operated at room temperature or slightly above (up to 40°C.), at current densities in excess of 50 amp./ft.^{2} (5.4 amp./dm.^{2}), and preferably around 75-100 amp./ft.^{2} (8.1-10.8 amp./dm.^{2}). Better electropolishing solutions than the above can probably be compounded, and the above composition is given mainly as a guide. However, even from the above bath, very smooth finishes (as low as 2.5 microinches rms) were obtained.

Zinc Strike

Cathodic treatment of titanium in a bath consisting of ethylene glycol, HF, a small amount of water, and a zinc salt showed that, on application of current, zinc deposited on the cathode at first, but soon redissolved even though no interruption of current occurred. If the specimen was removed before the redissolution of the zinc, the deposit could easily be scraped off. During and after dissolution of the zinc, a black film formed on the titanium surface. Deposition of copper on this black film gave adherent coatings. The electrodeposits adhered to the extent of passing the bend test when the deposits were 0.5 mil in thickness. These deposits did not pass the solderability test and heavier deposits, 3.0 mils to 5.0 mils in thickness, would not pass the bend test. The conditions required for formation of the black film differed greatly between the lots of commercially pure grades of titanium and titanium alloys used. Because of the difficulty of control and the inability to obtain satisfactory adherence, this approach was discarded.

Summary and Conclusions

Conventional methods used to obtain adherent electrodeposits on other metal fail in the case of titanium.

However, fully adherent copper electroplates (up to 0.005 in. thick) on titanium are obtained when the material is anodically etched, prior to plating, in a solution based on HF and ethylene glycol, under controlled conditions of temperature and current density. Metallographic examination indicates that the bond between plate and basis metal is a mechanical one, due to interlocking between the etched surface of the titanium and the plated metal which appears to "throw" well into the cavities created by the etch.

Under different operating conditions, an anodic treatment of titanium will yield an electropolished surface, which is not good for adherent plating.

Acknowledgment

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COMPLEX CUPROUS CYANIDE COMPOUND

(*Concluded from page* 64)

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EXTRACTS
From the World's Plating Literature

Effect on Plated Coatings of Metal Surfaces Pickled Under Various Conditions

R. Petri; *Metallaberflaeche,* vol. 6, No. II. pp. A170-A174.

Pickling of the metal surface can influence the subsequent plated coating in the following manner. In conjunction with the metal attack there occurs a more or less varied roughening of the surface which is related to the choice of the pickling process and the pickling conditions; further there is the adsorption of a certain amount of loosely-bonded hydrogen which will again issue from the material after a more or less lengthy period of time. The formation of thin films on the surface can be caused by an increased iron content of the bath, by the use of pickling inhibitors or by an enrichment of the secondary elements of the steel composition in the form of a coating. In this connection the elements which are nobler than iron have special significance because they become enriched in the metallic form on the surface of the iron or steel and, by virtue of their higher potential, can be removed only with difficulty. To what extent these influences become directly effective with later processing of the steel surface by plating depends upon as to how far they remain unchanged during the subsequent treatment or are covered by the deposit.

Tinning tests were conducted to provide information on these points, and to obtain data as regards in what way a metal surface which has been changed or modified by a pickling treatment, can act on an applied plated surface. The work was conducted on test pieces of silver steel 5 cm. in length with a diameter of 17 mm. The steel was in the bright drawn condition and degreasing alone was sufficient to provide a uniform starting condition. After various pretreatment, the test pieces were plated in an alkaline tin bath at temperatures of 73° to 75°C. and at a current density of 1 amp./sq. dm. The tin plating time was constant with all the test pieces. The tin was deposited from the bath in the matte condition. The tin coating was then brightened by immersing in an oil bath heated to 260°C. To obtain a critical judgment of the plated coating in relation to the chemical and physical properties of the base metal surface, the base metal condition, roughness, appearance and porosity were all taken into consideration. The surface appearance was determined from the specific nature of the aggregation of the tin coating on melting, this being governed to a considerable extent by the wettability of the base metal surface. The roughness of the base metal is accordingly here only co-determined to a certain extent with that of the plated coating, because, through the thermal tin-flowing stage, an aggregation of the tin coating occurs and consequently a balancing out of the surface roughness inasmuch as this is occasioned by the characteristic appearance of the cathode surface.

As regards to what extent thin films on the base metal surface after pickling influence the deposition of the plated metal depends partly on the extent to which these films are dissolved in the bath. On the assumption that initially only crystal nuclei are deposited on conducting surfaces by the electrolysis, then such films must fundamentally influence the structure of the plated coating. The formation of the tin coating was studied on four test pieces of different surface roughness. Any influence on the roughness of the plated coating could not be observed with base metal surface roughness craters of up to about 4 microns. Only with a base metal surface roughness of about 8 microns did pronounced roughening of the tin coating occur which was also not balanced out by the subsequent tin-flowing stage. The porosity of the coatings, in spite of progressively increased thicknesses, was about the same and, in the case of the test piece with a slightly rougher initial surface, somewhat lower. Tests were conducted to ascertain the effect if any, of pickling inhibitors on the subsequent plated tin coating. The appearance of the tin coating will be determined here principally by a change in the wettability of the base metal surface caused by the pickling film. Each test piece was pickled in 10% sulfuric acid with additions of inhibitors. To produce a pickling film as strongly developed as possible they were first immersed for 24 hours in the cold acid solution, then rinsed in flowing water and tin plated. The tin coating on the non-pickled, finely ground test piece, was fine-grained and uniform in comparison with the tin coatings formed on very rough base metal surfaces. The different pickling films formed on the metal, according to the nature of the pickling inhibitor used, all more or less change the wettability of the base metal surface. As regards the effect of the pickling films formed with Cu and Ni containing steels no appreciable differences in the effect on the structure of the plated tin coating could be established. The influence of increased carbon, nickel and sulfur content in the base metal (steel) was investigated. Non-metallic inclusions at the cathode surface would lead directly to interruptions in thin coatings; these interruptions will be grown over with further plating.

Influence of Surface Films on Hardness Measurements

W. Spaeth; *Metalloberflaeche,* vol. 6, No. 11, pp. A161-A163.

The general trend in modern hardness testing procedures is to conduct the impression test or scratch test with very small loads. Surface coatings on the metal to be investigated must, therefore, exert an influence on the result obtained to an increasing extent, but the role also of any intermediate film which is located between the penetrating body and the test surface warrants consideration. Numerous test measurements have been conducted previously by Whitehead regarding the influence of oxide coatings. To this end the friction

was investigated between steel and aluminum in a load region of 10 kg. down to a few mg. Within this very great load range the coefficient of friction was found to be constant; it amounted to about 1.3. By microexamination it was established that the effect on the surface with all loadings is similar. Always there is first shown plastic deformation in the ensuing groove, then metallic welding as well as tearing and shearing of portions of this welding, and this with the smallest loading. Such a behavior holds good for zinc, cadmium, pure iron and magnesium. The mechanism of the friction in these cases runs mainly the same over the loading range mentioned. For other metals however, this does not hold good. Thus in the case of the friction of copper on copper, for loadings over 10 grams the friction remains constant and the coefficient of friction amounts to about 1.5. If, however, the load falls below 10 grams then the coefficient of friction falls from a "high position" to a "low position" to only about 0.4 and remains constant with further falling loading. With high loadings, metallic welding is in evidence; with low loadings no welding effect could be discerned even with examination under the electron microscope. These noteworthy differences were explained by the very different hardness of oxide and metal. The Moh hardness of aluminum oxide is 9 and the hardness of aluminum metal is only 2. On this basis the oxide coating is not capable of protecting the underlying metal; rather it is immediately pierced at the slightest contact. This process can be compared with the behavior of a thin ice layer on a slushy undersurface. With approximately the same hardness of oxide and metal however, the oxide coating deforms uniformly with the underlying metal layer. At least for small loadings, the oxide coating accordingly does not break but is able to impede welding together of the mutual surfaces. The friction remains correspondingly small. Only when a critical load has been exceeded is the protecting oxide film broken. As copper and its oxide are of about the same hardness, the lack of welding and the frictional rise with increased loading are indicated. As regards the use of a diamond for hardness testing, investigation of the effect of absorbed films on the friction of diamond on diamond has shown that, with air entry, the friction is relatively low. It amounts to about 0.05 with a loading of 20 grams. As opposed to friction with metals, this decreases however with increased loading. With purification in a vacuum, the coefficient of friction at 20 grams loading rises to about 0.4. With the introduction of dry air it falls immediately to 0.1 and this process is reversible.

The question of boundary surface lubrication also enters into this question. With the opposing movement of metal coatings, one speaks of boundary surface lubrication if the lubricating film is so thin that only a few molecular layers are located between the metal surfaces. The occurring phenomena have been investigated by making one of the surfaces concerned radioactive. With the gliding of this artificial radioactive piece over the non-radioactive opposing surface metal particles which had been carried over from one surface to another by welding action were indicated by laying the non-active surface against a photographic plate. In this way, metal transposition could be discerned down to 10^{-11} g./sq. cm. With pure metals there was found a uniform gliding and with a load of 2 kg. a metal transposition of $20 - 40 \times 10^{-6}$ g./sq. cm. when opposing surfaces of similar metals were concerned. This metal transposition is, in addition, scarcely influenced by any particular hardness of the metal. With non-similar metals, this metal transposition is considerably smaller and it amounts to the extent of 1×10^{-6} g./sq. cm.

The translation of the above information to the question of metal hardness testing is of technical importance, because the technical literature on the subject shows many individual observations which still remained more or less unexplained. Thus, the nature of the preparation of the test piece has a great influence on the measuring results, particularly at low loads. Hardness penetration tests conducted in a vacuum on pure metals gave surprising and not unexpected results; using a metal penetrating body, welding fast to the test surface immediately followed. Under these conditions the Brinell cone was also sealed fast in the impression cavity and could not be removed. A cone falling from a certain height remained fixed fast. The Herbert pendulum test apparatus would not longer function. After introducing small traces of gases and vapors into the test apparatus, considerably fewer weld places occurred but the friction was still very great. With normal hardness testing with air entry, the nature of the oxidation and rapidity of this must be considered. For micro-hardness tests, the stress condition as a result of the different space lattice of oxide and base metal should be of significance. Two implications are presented with the cleaning of the metal surface to be tested. The better this cleaning is, the stronger under circumstances can disturbing influences become noticeable by friction. The lubricant used with the hardness test can mean that an intermediate film is present of only a few molecular layers.

Shop Problems

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Safety in Polishing Room

Question: We have been polishing silver plated holloware and flatware prior to the plating. Our problem has been an excessive number of accidents which have occured while working on polishing lathes. One type of accident most frequently occurs due to the use of cloth aprons which become entangled in the polishing wheel and very often result in injury to the person operating the machine. We have used aprons which are not made of too strong material to prevent a very serious injury. Although we have purchased rubber aprons, which we believed would be less apt to become entangled in the wheel, the polishers have refused to wear them because they are so hot and heavy.

In addition we have recently experienced an injury resulting from a cloth work glove being caught in the wheel of the machine. These gloves are used to prevent unnecessary finger marks on polished merchandise. If you have any suggestion as to safety precautions we could take along this line they would certainly be appreciated.

R. C. H.

Answer: Injuries from aprons and gloves catching in polishing wheels are not common and we are at a loss to make any recommendations which might be of help, aside from the obvious one of being more careful. If an apron is tied tightly, even a cloth one, there is no reason for it to get caught. When it starts tearing, it should be replaced immediately. Most polishers place a section of 12-16 inch buff in front of the apron to take the wear and hold it in place by punching holes on each side for cords which are tied in back.

Gloves should be fairly close fitting and should be replaced as soon as a rip shows, which might be caught in the wheel.

Spotting on Heat Treated Steel

Question: We have to gold plate on heat treated steel deposits of copper, nickel and finally gold. We have noticed that little pinholes form on the parts with colored circles of brownish and purplish. We cannot seem to eliminate this, but they will come off by running through our cleaning cycle. However, after a few days they reappear. Can you tell me what is causing this? We are using a high speed cyanide copper in barrel and next a magnesium barrel nickel, followed by alloy gold.

A. C.

Answer: The trouble seems to be the common one of spotting out. This is due to small pores in the deposit and probably results from particles of scale from the heat treating operation which do not take a deposit of copper or from overpickling, if the scale has been removed in acid solution. A bake at about 225°F. will help after plating, but attention should be concentrated on the surface preparation of the steel before plating to minimize porosity.

Aluminum Plating

Question: We are greatly interested in an article in the July issue of *Metal Finishing* regarding the "New Aluminum Plating Process." Would it be at all possible to receive further details regarding this process? How should one proceed to receive ampler details? We do not seem to understand this article at its fullest measure, and would appreciate further details.

R. J. S.

Answer: We would suggest that you write to Dr. Abner Brenner, National Bureau of Standards, Washington 25, D. C. He will be in a position to advise you as to the source of additional details.

Salt Residue on Cleaned Radiators

Question: We have a large wholesale operation on automotive radiators. We have used all the prepared caustic cleaners. Some worked all right for a short time, but all seem to leave a caustic or white deposit on the radiators when they dry, then seem to soften the solder and make it very hard to solder. We use a flush rinse of air and cold water after taking them out of boil vat. We have a good bit of grease on the inside of radiators, but the problem is the white deposit.

E. J. L.

Answer: The white deposit may be due to insufficient rinsing or to hardness in the water. We would suggest that you test the latter by allowing a film of water to dry on a sheet of clear glass. The proprietary cleaners would not be the cause, since they must rinse completely to permit subsequent finishing.

After cleaning and rinsing you might try dipping in a solution of weak sulfuric acid plus a small amount of dichromate. A typical formula will be ½ pint of acid and 2 ounces of dichromate, either sodium or potassium, followed by rinsing and drying.

Removing Cadmium from Chromium

Question: Can you give us a suggested method of removing cadmium plate from chromium plate? It is presently done by using steel wool, after soaking the piece in hot water, but process is too slow.

E. E. D.

Answer: Cadmium deposits may be readily removed from chromium plate by immersion in a solution consisting of 1 lb. ammonium nitrate per gallon of water, at room temperature. A solution of 1-2 oz./gal. nitric acid will also be satisfactory.

LEA newsreel

FEBRUARY 1954

THE LEA METHOD OF FINISHING

The Lea Manufacturing Company pioneered and continues to specialize in the development of CLEAN-WORKING polishing and buffing compositions. These special methods minimize cleaning by employing selected grades of LEA COMPOUND, LEAROK, or other special compositions which virtually eliminate excessive cleaning or hand-scrubbing common with regular heavy grease compounds.

Here are some typical case studies of Lea Methods.

CASE STUDY #1

Material: Sterling silver.

Article: Table flatware.

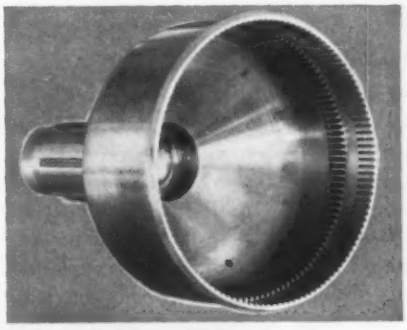
Method of Forming: Customary for this type of work.

Final Finish: Bright Butler.

Lea Method:

1. Cut-down buffing with Tripoli.
2. Cleaning.
3. Lea Compound Grade A-1 or 5023 on a 6" diameter loose muslin buff at 4400 r.p.m.

Remarks: The Lea Method produces a more pleasing finish in about half the time than that produced by any wet method. When a more pronounced Butler finish is desired, a packed buff with Grade A-63 Lea Compound is used.



CASE STUDY #2

Material: Steel.

Article: Bearings, motor parts and other aircraft engine parts, some with counter-sunk holes.

Method of Forming: Forging.

Final Finish: Smooth with burrs removed and slight radius provided.

Lea Method:

Lea Compound Grades "L," "B" or "C" at 5500 surface feet per minute on various types of buffs, string brushes, leather bobs, etc., depending upon the shape of the piece and the accessibility of the surface to be abraded.

Remarks: Work of this type had previously been done by hand with files, emery cloth or burring tools. Lea Compound removes all metal marks and burrs much faster and more economically than hand work. Tolerances are protected by the flexibility of the Lea Compound wheel.

CASE STUDY #3

Material: Brass and bronze.

Article: Bookends and novelties.

Method of Forming: Casting.

Final Finish: Brushed effect.

Lea Method:

1. Lea Compound Grade "C" on 8" loose wheel at 1500 to 2000 r.p.m.
2. Lacquering.

Remarks: Lea Compound is especially applicable to this type of work as there are numerous recesses in which buffing dirt would lodge with the older method using Tripoli buffing and wet scratch brushing. Accordingly, costly hand cleaning is thereby eliminated.

CASE STUDY #4

Material: Brass.

Article: Door knobs and escutcheon plates.

Method of Forming: Stamping.

Final Finish: Oxidized and relieved.

Lea Method:

1. Cut-down buffing with Tripoli of surface previously polished.
2. Clean.
3. Oxidized in liquid sulphur.
4. Lea Compound Grade "FG" on a 12" diameter loose muslin buff at 1200 r.p.m.
5. Lacquering.

Remarks: Grade "FG" Lea Compound gives a medium butler relieving which requires no cleaning or drying before lacquering.

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Electropolishing Chromium

Question: We are quoting on a job for the Army Ordnance for chrome plating and electropolishing on hard chrome, which we presume is a very new process. We are familiar with electropolishing of stainless steel, but not of hard chrome. We would greatly appreciate your advising us as to where we could obtain instructions, or if you are in a position to advise us of someone who is doing this process who might grant us the privilege of seeing how they do it or explaining to us how it is done.

H. M.

Answer: Our files show only one reference on electropolishing chromium, a Japanese patent issued in 1950 to Fuji Electro-Engineering Co. The solution consists of:

Sulfuric acid	30-50%
Ethyl alcohol	40-50%
Water	Balance

Are you sure the part calls for electropolishing? You should check first to see whether etching of the chromium plate to produce a porous, oil-retaining surface is what the part requires.

Gold Colored Barrel Brass

Question: Enclosed are samples with the type of finish which is very desirable for our line of buckles. We have been trying to get the right gold tone and lustre but as yet have been unsuccessful. We have a 200 gallon tank with two horizontal Lucite barrels, a rectifier with 10 volts and 300 amp., and use a solution a little stronger than that in your *Guidebook-Directory*. We have tried plating nickel over a highly polished surface, then brass-plating. We can usually obtain the luster but cannot get the gold-tone color.

L. F. Z.

Answer: The finish appears to be an off-color brass on highly burnished steel. We would suggest that you double the zinc content of your brass solution to obtain the "zinc pink" effect and operate the solution at about 120-130 deg. F. Maintain the pH at 12.5 with caustic soda. Do not use ammonia in a brass solution when pink colors are desired.

Silver Plating Zinc

Question: We have been silver plating a great lot of zinc pieces in our silver bath, such as old time coal oil lamps and also a good number of zinc statues and we notice that in the process of plating there is a lot of boiling taking place out of the bottoms and holes where the solution runs out.

We were wondering whether the zinc which is being attacked by the solution would have a tendency to throw the silver down to the bottom of the tank, since the bath does not work as well afterwards on other metals such as copper, brass and pewter hollow ware. We were told that to throw the silver down in a silver bath one throws a lot of zinc dust in the bath and, in doing this, you could reclaim the silver.

If this were the case, would this zinc that is not plating on the bottoms and insides of these statutes throw some of the silver in the bath down, and how could we get the silver back in the bath again?

P. R. G.

Answer: Silver is reclaimed from old solutions by precipitation with zinc dust. In your case, however, the silver will not drop to the bottom of the tank but will adhere to the zinc surface on the insides of the parts as a spongy deposit. The result will be a decrease in silver content of the bath, since this type of deposit is not replaced from the silver anodes, and an increase in the zinc content in direct proportion chemically. The dissolved zinc does not plate out at ordinary operating voltage but you may get an inferior deposit because of the decreased silver content of the solution.

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PATENTS

Cleaning Machine

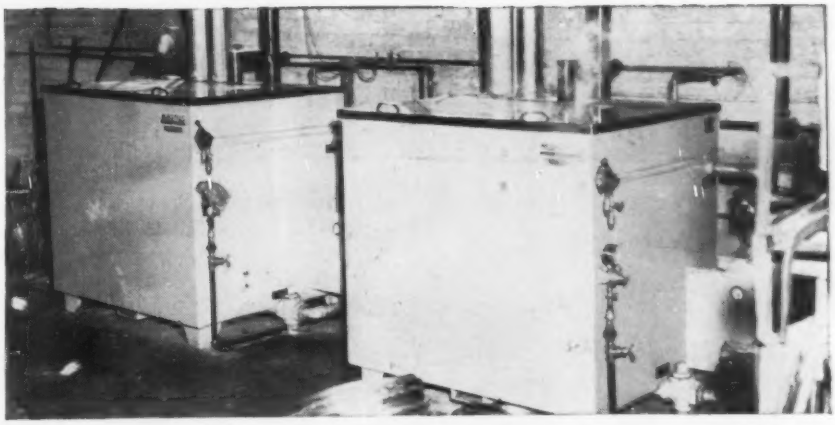
U. S. Patent 2,651,311. *Sept.* 8, 1953. *J. D. Rule, assignor to Kewanee Industrial Washer Corp.*

A cleaning apparatus comprising a tank, a reticulated support for articles to be cleaned removably disposed in said tank, said tank being adapted to contain a supply of cleaning fluid extending from the bottom of the tank to a substantial distance above the said support, said tank having an outlet for the fluid in a vertical wall and below the normal fluid level and an inlet for said fluid in the same wall at a higher level than said outlet, a housing mounted exteriorly of the tank and providing a smoothly curved passageway connecting the inlet with the outlet, an impeller mounted for rotation in said passageway adjacent said outlet, and means for rotating said impeller in a direction and at a speed to draw fluid through said outlet, to elevate said fluid through the passageway, and to discharge it forcibly through said inlet into the tank, together with a drain tank mounted adjacent the first- mentioned tank and dimensioned to receive the reticulated support, a supply conduit for rinsing fluid adjacent the drain tank with a spray device connected thereto, a constantly open outlet leading from said tank, and a heater disposed under the first-mentioned tank for maintaining the cleaning fluid therein at high temperature.

Pusher Type Automatic Plating Apparatus

U. S. Patent 2,650,600. *Sept.* 1, 1953. *J. V. Davis, assignor to The Udylite Corp.*

In a conveying apparatus, a series of receptacles, an alined series of spaced rail sections fixidly supported over said receptacles, a chassis movably mounted over said receptacles, means for moving said chassis up and down over said receptacles, a series of spaced rail sections carried by said chassis and adapted to fit in the spaces between the first named sections in the lower position of the chassis, slidably mounted pusher bars carried by said chassis, means for reciprocating said bars, lengthwise adjustable pushers carried by said bars in close proximity to the movable rail sections and adapted to engage work on the several rail sections in either position of the chassis, and means for sliding said bars in both positions of the chassis.



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Buffing Wheel

U. S. Patent 2,651,151. *Sept.* 8, 1953. *F. E. Hendrickson, assignor to Murray Ireland.*

A buffing wheel comprising an endless band buffing element of fabric material folded medially lengthwise to form an annular disk and having mounting openings therein, a disk-like mounting hub having peripherally spaced and outwardly tapered mounting fingers, the fabric being arranged when forced at an opening along a mounting finger to stretch and exert pressure thereagainst, and a retainer lock for each finger having one end enlarged for holding the mounted band thereon and its other end extending along the finger through the fabric opening and terminating in a hook to engage in an opening in the finger, the cooperation of parts being such that when said enlarged end of the lock is forced against the fabric and along the tapered finger to a hook engaged position the stretched fabric around the opening exerts tension on and maintains said finger and lock in hook engaged position.

Etching Aluminum

U. S. Patent 2,650,875. *Sept.* 1, 1953. *V. Dvorkovitz and J. R. Swihart, assignors to The Diversey Corp.*

In the etching of articles of aluminum and of aluminum base alloys, the

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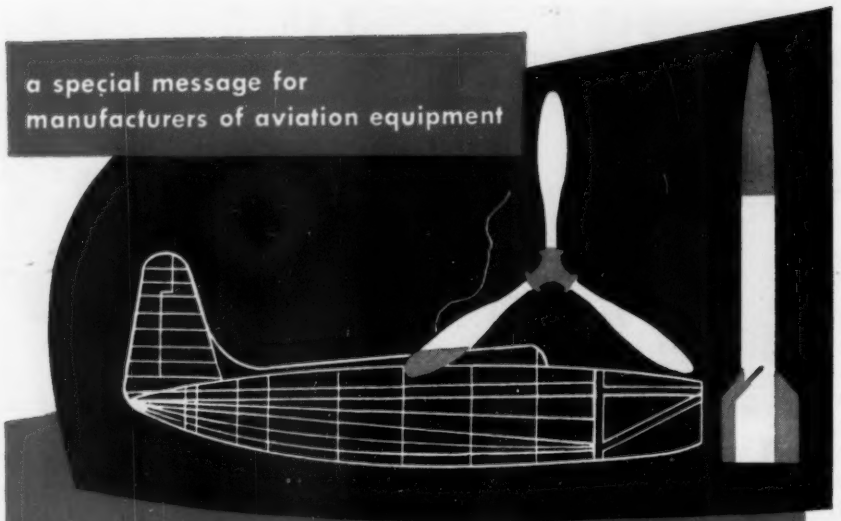

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ON COPPER . . . Iridite brightens copper, keeps it tarnish-free; also lets you drastically cut the cost of copper-chrome plating by reducing the need for buffing.

ON ALUMINUM Iridite gives you a choice of natural aluminum, a golden yellow or dye colored finishes. No special racks. No high temperatures. No long immersion. Process in bulk.

ON MAGNESIUM Iridite provides a highly protective film in deepening shades of brown. No boiling, elaborate cleaning or long immersions.

AND IRIDITE IS EASY TO APPLY. Goes on at room temperature by dip, brush or spray. No electrolysis. No special equipment. No exhausts. No specially trained operators. Single dip for basic coatings. Double dip for dye colors. The protective Iridite coating is not a superimposed film, cannot flake, chip or peel.

WANT TO KNOW MORE? We'll gladly treat samples or send you complete data. Write direct or call in your Iridite Field Engineer. He's listed under "Plating Supplies" in your classified phone book.

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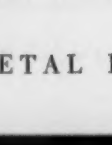
Manufacturers of Iridite Finishes for Corrosion Protection and Paint Systems on Non-Ferrous Metals, ARP Plating Chemicals.
WEST COAST LICENSEE: L. H. Butcher Co.



method which comprises treating the surface of said article with a hot aqueous solution comprising an etching alkali and a small amount of water-soluble saturated aliphatic polyhydroxy compound in a proportion such that the formation of a hard adherent precipitate is avoided for an extended period of time, said compound being selected from the class consisting of polyhydric alcohols of the formula $CH_2OH(CHOH)_aCH_2OH$ wherein a is at least 2, starches of the formula $(C_6H_{10}O_5)_x$, polyhydroxy monobasic acids of the formula

$$COOH(CHOH)_cCH_2OH$$

wherein c is at least 4, polyhydroxy dibasic acids of the formula $COOH(CHOH)_dCOOH$ wherein d is at least 3, gum arabic and the alkali metal salts of said acids.

Aluminum Bath

U. S. Patent 2,651,608. *Sept.* 8, 1953. *A. Brenner and D. E. Couch, assignors to The United States of America.*

A process of electroplating that comprises electrodepositing aluminum from a bath consisting of a mixture of an ether selected from the group consisting of ethyl ether, ethyl n-butyl ether, a mixture of ethyl and butyl ethers, anisole, phenetole, and diphenyl ether; a metal hydride at 0.5 to 1 molar selected from the group consisting of lithium hydride, lithium aluminum hydride and aluminum hydride; and anhydrous aluminum chloride at from 1 to 4 molar.

Thickness Testing Instrument

U. S. Patent 2,651,846. *Sept.* 15, 1953. *T. R. Rudge, assignor to The General Electric Co., Ltd.*

Apparatus for measuring the thickness of layers of non-magnetizable material on magnetizable materials comprising, a bar magnet, a single contact-making unit of magnetizable material, said unit being in contact with one end only of the bar magnet and having a contact-making surface at least part of which in operation is brought into contact with the surface of the material on which measurements are to be made, the said contact-making surface being smooth and non-concave and having a configuration such that the tangents at the points on said surface which in operation are brought into contact with the surface of said material are inclined to the longitudinal axis of the bar magnet, a moving-iron

element, means for supporting the moving-iron element near the midpoint of the bar magnet said means permitting rotation of the moving-iron element about an axis fixed with respect to the bar magnet, means for exerting a force biassing the moving-iron element towards a chosen orientation about said axis of rotation, and a scale and an associated index coupled to the moving-iron so as to move across the scale in dependence upon rotations of the moving-iron element about said axis of rotation.

Plating Rack

U. S. Patent 2,652,359. *Sept.* 15, 1953. *M. S. Schneider.*

In an electroplating rack the improvement which comprises an electrically conducting bus-bar, an electrically conducting sleeve and a hook both in electrical contact therewith, and a freely removable resilient wire article support extending with one free end into said sleeve and resiliently pressing against said hook, its other free end being bent to engage an article which is to be plated.

Flexible Abrasive Wheel

U. S. Patent 2,651,894. *Sept.* 15, 1953. *G. O. Leggett, assignor to Merit Products, Inc.*

A flexible abrasive wheel comprising an annular pack of superimposed flaps having face portions coated with abrasive material, a strip of sheet material adhered to and binding said flaps together at their ends where said flaps border the space at the center of the annular pack, there being two oppositely disposed grooves in the side edges of said flaps circumjacent to said binding strip, a ring occupying the bottom portion of each of said grooves and inwardly spaced from the mouth of the groove, a hub structure comprising two concentric circular side plates, each of said side plates having a laterally directed peripheral flange, said flanges occupying the mouth portions of said grooves and abutting said rings, said side plates also each having circumjacent to its periphery an annular shoulder which internally abuts the adjacent side edge portion of the aforesaid binding strip, and clamping means extending through said hub structure to draw said plates toward each other thus firmly maintaining said flanges in abutting relations to said rings.

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The engineering and construction features of INDUSTRIAL filters add up to maximum clear filtrate with less floor space, greater operating conveniences, and less maintenance delays and expense. The general design permits the use of the materials best suited to the solution requirements. Vertical filter leaves with ample flow space on both sides offer maximum filtration area. Outside lockup simplifies the installation of filter leaf and bag assemblies. An exclusive air-wash cleaning method practically eliminates the usual labor and inconvenience of dismantling the filter after every cycle. INDUSTRIAL filters are often in operation for months without removing the cover — cutting downtime to a minimum. All these features have been proved in long-life service — your assurance of dependable bonus performance.

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Magna-Gage and Microscopic Thickness Tests and Salt Spray.
Complete Laboratory Control.

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Assistance gladly rendered on Dimensional Allowances or other Plating Problems. No Obligation. Samples plated without charge.

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CUTTING *and* TUMBLING BARRELS

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For uniform cutting down, wet or dry grinding, tumbling, pulverizing and mixing, the unique design of Hartford Triple Action Barrels saves time and money and produces better results. Hartford Barrels give a TRIPLE ACTION in tumbling the material, an "over and over, end to end, folding-in" motion combined, which quickly grinds off burrs, and finishes and smooths the general surface of any article in the load. These barrels are available in two sizes, large and small, and with both motor and belt drive. Hartford also makes steel burnishing balls scientifically correct in design and material for each specific job. Bulletin on request.

2H552

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LOS ANGELES, CAL. — E. D. MALTBY CO. — 1719 SOUTH FLOWER ST
EXPORT — R. A. RODRIGUEZ, INC. — 55 W. 42ND ST., NEW YORK

Acid Copper Plating

U. S. Patent 2,651,609. *Sept.* 8, 1953.
A. E. Chester, assignor to Poor & Co.

In a method of controlling the electrodeposition of copper from an acid copper sulfate plating bath onto an electrically conducting object of a type in which the copper would normally be deposited in greater concentrations in some areas than in others by a direct plating current; the step which comprises electrodepositing the copper by subjecting said object in an acid plating bath to a plating current having an asymmetric alternating wave form comprising an alternating current superimposed on a direct current in the ratio of 2-4 volts R.M.S. to 2.5 volts D.C., regardless of the specific current values, at current densities from about 2 to about 15 amperes per square foot.

Acid Zinc Plating

U. S. Patent 2,651,610. *Sept.* 8, 1953.
A. E. Chester, assignor to Poor & Co.

In a method of controlling the electrodeposition of zinc from an acid zinc sulphate plating bath onto an electrically conducting object of a type in which the zinc would normally be deposited in greater concentrations in some areas than in others by a direct plating current; the step which comprises electrodepositing the zinc by subjecting said object in an acid plating bath to a plating current having an asymmetric alternating wave form comprising an alternating current superimposed on a direct current in the ratio of 2-4 volts R.M.S. to 2.5 volts D.C., regardless of the specific current values, at current densities from about 2 to about 15 amperes per square foot.

Conductor Roll for Apparatus for Electrolytically Treating Strip

U. S. Patent 2,652,461. *Sept.* 15, 1953.
C. J. Klein, assignor to National Steel Corp.

A conductor roll for making electrical contact with and conducting electrical current to a moving strip comprising an elongated integral tubular body member formed of a conductive metal having an internal substantially cylindrical surface and an external substantially cylindrical surface for making electrical contact with the surface of the moving strip, the internal surface of the body member including a threaded surface portion, supporting means mounted at the ends

of the body member for rotatably supporting the body member for rotation about its longitudinal axis, the supporting means including a supporting member at one end of the body member having a longitudinal bore concentric with the longitudinal axis of the body member, and an integral electrical current conductor member formed of conductive metal having a relatively lower electrical resistance than the supporting member for connecting the body member to a source of electrical current, the integral conductor member including a first portion extending outside the supporting member and adapted to be connected to a source of electrical current, a second portion extending through the bore of the supporting member and an enlarged portion extending into one end of the body member, the enlarged portion including an external threaded substantially cylindrical surface having a diameter substantially equal to the diameter of the threaded surface portion of the internal surface of the body member, and the external threaded surface on the enlarged portion of the integral conductor member threadedly engaging the threaded surface portion of the body member to form a mechanical connection and a low resistance electrical connection between the integral conductor member and the body member.

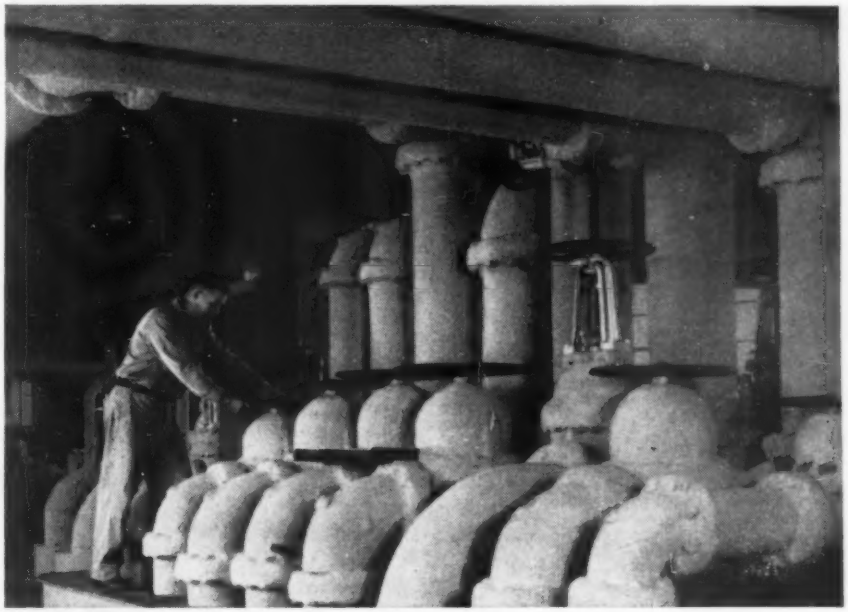
Tungsten Alloy Plating

U. S. Patent 2,653,128. *Sept.* 22, 1953. *A. Brenner, P. S. Burkhead and C. A. Sentel, assignors to the United States of America.*

The method of electroplating a metal object with an alloy composed of tungsten and at least one metal of the group consisting of iron, cobalt and nickel; which method comprises connecting the object to be plated as a cathode in an electrolytic bath consisting of an aqueous alkaline solution of soluble salts that supply to said solution tungstate ions and a complex consisting of ammonium ions plus ions of at least one metal of the group consisting of iron, cobalt and nickel, plus aliphatic organic ions having at least three hydroxyl and carboxyl groups in sum total, said soluble salts being substantially non-reactive chemically with the said metal object upon which the tungsten alloy is being electroplated, and plating said metal object with the tungsten alloy.

LARGE DIAMETER PIPING HANDLES DE-IONIZED WATER

Installation of large diameter SARAN RUBBER lined pipe, fittings and valves safely transports de-ionized water without contamination



Saran rubber has served over three years in this water-conditioning plant without a shutdown. De-ionized water for chemical processing is transported and stored with complete safety in pipes and tanks lined with saran rubber.

Illustrated is part of this important installation showing 8", 10" and 12" diameter saran rubber lined pipe, fittings and valves used for the transportation of large volumes of de-ionized water. This installation has proved to be so successful that a duplicate water-conditioning plant, doubling the output of de-ionized water is currently under construction with saran rubber again specified as a lining for pipe and tanks.

This same chemical water-conditioning plant employs saran rubber lined tanks for the acid regeneration of ion exchange resins. Consult your nearest authorized saran rubber applicator for your process lining problems or contact your local SARAN LINED PIPE COMPANY office for a list of applicators who service your plant. Offices in New York • Boston • Pittsburgh Tulsa • Philadelphia • Chicago Portland • Indianapolis • San Francisco • Houston • Salt Lake City Los Angeles • Seattle • Cleveland Charleston, S. C. • Toronto • Montreal.

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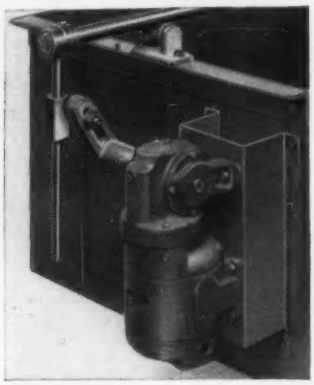
Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

Vertically Mounted Rod Agitator for Plating Racks

Belke Mfg. Co., Dept. MF, 947 N. Cicero Ave., Chicago 51, Ill.



Important saving in clearance required for mounting is achieved by a new rod agitator.

The new unit is vertically mounted. Operation requires but 12" beyond the end of the tank compared to 24" required by normal, present day models — very necessary when tanks are close to wall or close to each other.

The new agitator is available in single and double rod types. Powered by a ¼ horsepower geared head motor drive unit with fully enclosed gears operating in oil. The standard speed is 17 strokes per minute. Stepless stroke adjustment from 3⅛ to 8 inches. Literature on request.

Addition Agent for Brass Solutions

Jelco Products, Dept. MF, 153 E. 26th St., New York 10, N. Y.

As the result of a long period of experimentation and trial, the above company is now ready to market a line of plating addition agents. The first of these materials is "Brass Additive" for which the following claims are made:

Will assist in maintaining an even brass color.

Will eliminate cyanide and ammonia fumes while solution operates.

Increases both efficiency and throwing power. Gives brighter, faster deposit.

Can be added to any standard brass plating solution.

Aids in anode depolarization.

Allows higher current density to be used.

Full information is available from the manufacturer.

Hot Melt, Strippable Coating

Fidelity Chemical Products Corp., 470-474 Frelinghuysen Ave., Newark, N. J.

A new "Dip-Pak" formula, No. 661, has been announced, which is a hot-melt, strippable coating that exhibits no oil exudation up to temperatures of 160°F.

This formula, which has cellulose acetate butyrate as its base plastic, is transparent, clear and extremely resistant to darkening under heat. A fairly tough, rubbery thermoplastic compound, the product will remain flexible at temperatures ranging from 50°F. to 160°F. It functions as a semi-permanent coating for metal objects, as a strippable coating for metal, as an insulating and potting compound for objects not subjected to heat in excess of 160°F., and as a plating stop-off. This formula is to be used when no oil exudation is desired.

This compound offers excellent resistance to corrosion. Melting temperature is 360°F. in melting pot—application range is from 320°F. to 350°F.

Hull Cell for Operation at Elevated Temperatures

R. O. Hull & Co., Inc., Dept. MF, 1300 Parsons Court, Rocky River 16, O.

Model "WT" is the latest development in Hull cells which provides a simple and accurate method for control of plating baths operated at elevated temperatures.

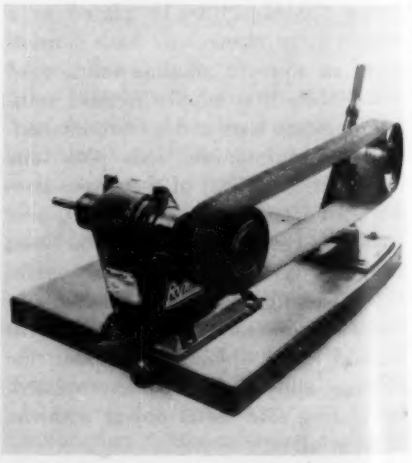
According to the manufacturer, the complete unit consists of a Lucite cell mounted with a waterproof, variable-control thermostat (containing a pilot signal light). This is connected in a series with a 110 volt (A.C. or D.C.) quartz immersion heater located in the base of the unit. Thermostat automatically controls temperature at plus or minus 3°F. The new cell uses the same size cathode as the 267 ml. cell.

Bench Backstand Uses Air-Inflated Contact Wheel

Nu-Matic Grinders, Inc., Dept. MF, 8224 Carnegie Ave., Cleveland 3, O.

This new bench, belt grinding machine for deburring gears, finishing small castings, grinding all types of stampings and similar operations, is offered with the claim that the unit speeds up grinding operations by as much as 500%.

Being air-inflated, the Nu-Matic contact wheel is resilient and flattens out like an auto tire at point of con-



tact. Thus, abrasive contact area is increased up to 3,000%. Results — faster finishing.

The unique design of wheel also provides increased belt life due to the self-cleaning action developed as the belt passes over the flattened wheel area and since the wheel equalizes belt stresses, smoother finishes because chatter, bounce and swirl marks are eliminated, faster finishing of contoured surfaces because the resilient drum shapes itself to the surface of the work and provides increased contact area.

The backstand assembly is designed for use with a 60" abrasive belt and will accommodate 5" and 8" diameter drums. The idler wheel is mounted on a spring-loaded lever that is manually operated to facilitate quick belt change. This lever also maintains proper belt tension. The complete assembly is mounted on a steel base or in any other way desired. However, the drive motor is always mounted underneath. Motor, motor mount and steel legs to make a table model are all available accessories.

Abrasive Chips for Barrel Finishing

Chicago Wheel and Mfg. Co., Dept. MF, 1101 W. Monroe St., Chicago 7, Ill.

The company has announced the marketing of a new precision barrel finishing chip, called Novaculite. Among the advantages of the new product, according to the manufacturer, are that chips of this material have unusually long life, will reach hard-to-get-at indentations without wedging or clogging holes, and will not change the work. It is also stated that the chips produce an unusually fine finish to close tolerances, with uniform radii on all edges of the work.

The manufacturer states that the chips have a unique conchoidal shape, irregularly formed with sharp edges and elongated points. This means that a larger size chip can get at hard-to-reach cavities, doing the work of small chips without the danger of clogging.

In precision barrel finishing such chips are said to produce a mild honing abrasive action for a smooth even finish without dents, burs, or damage to stamped or cast parts. Because they do not charge the work with abrasives or extraneous materials, such as iron oxides, the manufacturer states that

CIRCO MONORAIL DEGREASER

CIRCO DEGREASERS
Use 30% Less Solvent
CUT LABOR COST 10 TO 50%

Can you afford the high cost of outmoded metal cleaning equipment? The new, modern Circo vapor degreasers—whether large or small—are engineered to save you 30% in solvent consumption and up to 50% in labor costs through more efficient design and operation. Circo, drawing on a background of 30 years experience in vapor degreasing, builds into its equipment such solvent-saving features as balanced condensing coils, leak-proof pumps, dual vapor-level control and regulated heat input. Circo degreasers are built to perform faster, save precious man-hours, through such construction features as easy access and clearance on two sides, large clean out doors, and well-placed controls and switches.

And ONLY Circo-engineered designs can provide these additional advantages:

1. Immediate interchangeable operation, Trichlorethylene or Perchlorethylene
2. 208 standard designs to choose from
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Profit from Circo's firm policy of constant research and study that adapts the latest and best in metal cleaning to YOUR requirements.

And now — Circo Pioneers In Ultrasonic Cleaning

Circo again leads the way with the most modern and talked about metal cleaning development of the century. The new Circosonic Degreaser, equipped with General Electric ultrasonic generator, cleans metal parts by the power of sound—faster than ever thought possible and to a degree of cleanliness that passes the most stringent industrial standards. The Circosonic degreaser may fit your operating needs.

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Custom Designed Controls
Custom Developed Solutions
Custom Designed Equipment
Custom Consulting & Laboratory Service
Custom Engineering & Analytical Service

performance

Technic Inc. researches and develops methods and products for metal processing and finishing. We do not process or finish metals ourselves, but as consultants and suppliers we enable our patrons to perform these operations more efficiently and economically. Among the operations we can equip you to do better at lower cost are:

Controlled Color Gold Plating
Controlled Barrel Gold Plating
Controlled Heavy Gold Plating
Controlled Specification Gold Plating
and
Controlled Rhodium Plating

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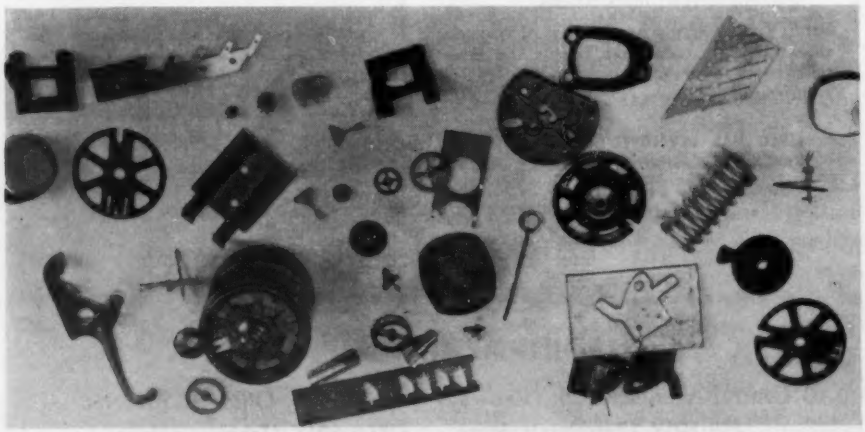
they offer particular advantages for finishing parts to be used in electronic assemblies or parts that would subsequently be used for plating.

According to the manufacturer, test production runs passed rigid inspections where precision barrel finishing with other types of abrasives had not proved practicable and the work had gone back to hand finishing. Savings on precision barrel finishing it is stated, from other tests, can result in as much as 97% of direct labor costs and increase production as much as five times.



Parts finished with Novaculite. Notice intricate design, deep holes and delicate construction.

New Plating Barrel

The G. S. Equipment Co., Dept. MF, 5317 St. Clair Ave., Cleveland, O.

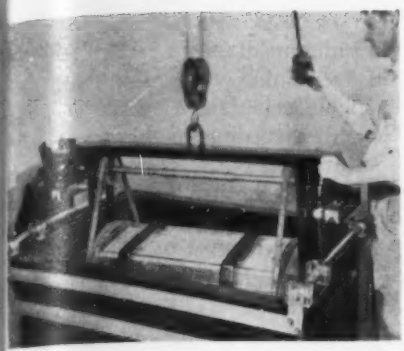
A revolutionary plating barrel design offering the industry's highest rate of plating production with savings of up to 100% in maintenance man-hours is claimed for the new barrel. It features a radically simplified mechanism, introducing several major developments which increase production and versatility while greatly reducing investment, maintenance and operational costs.

An exclusive, patented, dual V-belt suspension-drive eliminates transmission gears and cylinder bearings which are subject to wear and corrosive damage. The cylinder is suspended in the tank from the superstructure by 2 equal-length V-belts running from drive shaft pulleys to the grooved circumferences at both ends of the cylinder. The belts support the weight of the cylinder while transmitting the power for rotation. Belts are made of acid-, alkali- and stretch-resistant composition, guaranteed 2000-lb. capacity, and heat-resistant to well over 200°F.

Cathode contact is made by a unique self-cleaning, inverted V-block, 12" long, on each end of the superstructure. These provide 16" more contact area than the next longest in the industry and carry up to 30% greater current flow per load. As the superstructure is lowered on the tank, a guide channel directs it quickly and automatically into proper operating position, and firmly seats the inverted V-blocks on the round cathode rods located on the tank rim.

Of special value is the unique adaptability of its superstructure and cylinder assembly to fit on other plating tanks of conventional design. Platers can thus benefit from the many advantages of this modern, gearless, low-maintenance design without sacrificing their present tanks and auxiliary equipment.

The usual problems of dismantling and assembly have been overcome by an exclusive principle using self-locking U-plates of "H-T Sincolite" fitted over the floating hubs at each end of



the cylinder. A simple sliding-out of U-plates unlocks the assembly permitting cylinder interchange in 4 minutes, or cleaning and replacing danglers in 1½ minute without tools of any kind.

The Gill-Singleton cylinder is of "H-T Sincolite," heavy-ribbed design and fusion-welded construction throughout. It is noted for its rugged durability and long life, and has been proven suitable for all processing in acid or alkaline solutions at temperatures up to 200°F.

Other features are total immersion of cylinder in solution, no parts other than neoprene rubber and "H-T Sincolite" are exposed to the solution, easily interchangeable pulleys vary the speed of cylinder revolutions.

The new barrel is offered in all standard sizes and in multiple units. Complete construction and performance details are presented in the firm's new Bulletin GSB-101 now available from the manufacturer on request.

Dual Purpose Respirator

Chicago Eye Shield Co., Dept. MF, 2300 Warren Blvd., Chicago 12, Ill.

A dual purpose respirator, with twin cartridges for organic vapors or filters for dust has just been announced.

The facepiece of this respirator is contoured of soft rubber to provide snug, comfortable, leakproof fit even with light tension on the two adjustable headbands.

As No. 99 Respirator, for organic vapors, it has twin 85cc cartridges with inhale and exhale check valves to prevent rebreathing. Cartridges are quickly replaced from front by unscrewing retainer caps. As No. 96 Respirator, for dusts, it has twin treated wool-felt filters with high filtration factor. Because there are no outer screens or covers over filters, entire surface area of each is usable, thereby prolonging filters' life and reducing breathing resistance. Filters are quickly replaced from front same as on No. 99.

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● The Mutual name and trade mark on a Chromic Acid drum guarantee a product with a minimum assay of 99.75% and a sulfate content not exceeding 0.1%. Chromic Acid of that purity may be used with confidence in any of the above applications.

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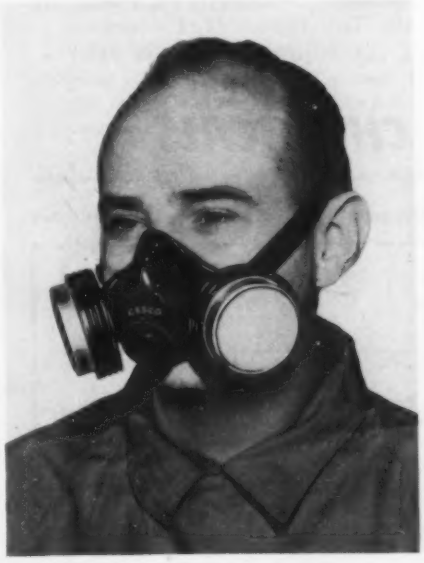

This dual purpose respirator is economical because it reduces inventories of parts. It is necessary to buy only one complete respirator plus other elements desired.

Barrel Finishing Compound

Minnesota Mining and Manufacturing Co., Dept. MF, 900 Fauquier St., St. Paul 6, Minn.

A new multiple purpose barrel finishing compound said to produce brighter finishes in less time on a very wide range of metals has recently been introduced.

Called "Honite" brand Multi-Burnish compound, it can be used for burnishing operations where three or four conventional compounds were previously required. In addition, it

TECHNIC INC.

products

Technic Potassium Gold Cyanides Concentrated Aqueous and Dry
Technic Alloys for the Production of all Decorative Shades
Technic Rhodium Concentrates for Heavy and Decorative Plating
Technic Immersion Tin for Fast Non Electrolytic Tinning of Brass and Copper
Technic Protectox-Antitarnish Treatment for Precious Metal and Copper Surfaces
Technic Flame Flux for Hard Soldering without Oxidation
Plating Equipment and Rectifiers for all Specialized Requirements

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Custom Designed Controls
Custom Developed Solutions
Custom Designed Equipment
Custom Consulting & Laboratory Service
Custom Engineering & Analytical Service

performance

Technic Inc. researches and develops methods and products for metal processing and finishing. We do not process or finish metals ourselves, but as consultants and suppliers we enable our patrons to perform these operations more efficiently and economically. Among the operations we can equip you to do better at lower cost are:

Controlled Color Gold Plating
Controlled Barrel Gold Plating
Controlled Heavy Gold Plating
Controlled Specification Gold Plating
and
Controlled Rhodium Plating

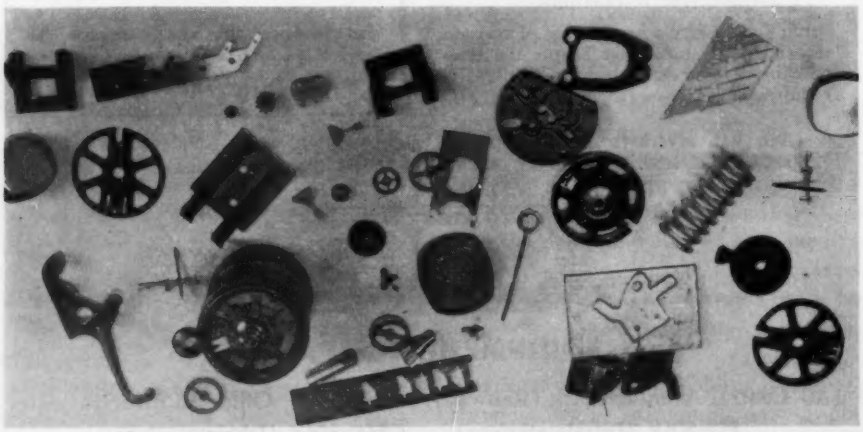
TECHNIC INC.

39F Snow St., Providence, R. I.

THE LARGEST ENTERPRISE OF ITS KIND IN THE WORLD

they offer particular advantages for finishing parts to be used in electronic assemblies or parts that would subsequently be used for plating.

According to the manufacturer, test production runs passed rigid inspections where precision barrel finishing with other types of abrasives had not proved practicable and the work had gone back to hand finishing. Savings on precision barrel finishing, it is stated, from other tests, can result in as much as 97% of direct labor costs and increase production as much as five times.



Parts finished with Novaculite. Notice intricate design, deep holes and delicate construction.

New Plating Barrel

The G. S. Equipment Co., Dept. MF, 5317 St. Clair Ave., Cleveland, O.

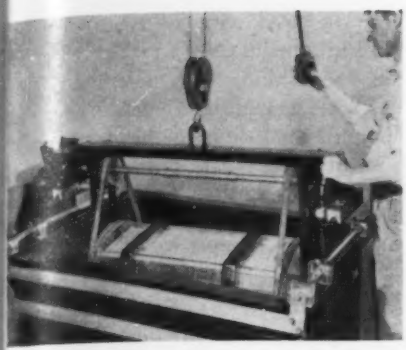
A revolutionary plating barrel design offering the industry's highest rate of plating production with savings of up to 100% in maintenance man-hours is claimed for the new barrel. It features a radically simplified mechanism, introducing several major developments which increase production and versatility while greatly reducing investment, maintenance and operational costs.

An exclusive, patented, dual V-belt suspension-drive eliminates transmission gears and cylinder bearings which are subject to wear and corrosive damage. The cylinder is suspended in the tank from the superstructure by 2 equal-length V-belts running from drive shaft pulleys to the grooved circumferences at both ends of the cylinder. The belts support the weight of the cylinder while transmitting the power for rotation. Belts are made of acid-, alkali- and stretch-resistant composition, guaranteed 2000-lb. capacity, and heat-resistant to well over 200°F.

Cathode contact is made by a unique self-cleaning, inverted V-block, 12" long, on each end of the superstructure. These provide 16" more contact area than the next longest in the industry and carry up to 30% greater current flow per load. As the superstructure is lowered on the tank, a guide channel directs it quickly and automatically into proper operating position, and firmly seats the inverted V-blocks on the round cathode rods located on the tank rim.

Of special value is the unique adaptability of its superstructure and cylinder assembly to fit on other plating tanks of conventional design. Platers can thus benefit from the many advantages of this modern, gearless, low-maintenance design without sacrificing their present tanks and auxiliary equipment.

The usual problems of dismantling and assembly have been overcome by an exclusive principle using self-locking U-plates of "H-T Sincolite" fitted over the floating hubs at each end of



the cylinder. A simple sliding-out of U-plates unlocks the assembly permitting cylinder interchange in 4 minutes, or cleaning and replacing danglers in ½ minute without tools of any kind.

The Gill-Singleton cylinder is of "H-T Sincolite," heavy-ribbed design and fusion-welded construction throughout. It is noted for its rugged durability and long life. and has been proven suitable for all processing in acid or alkaline solutions at temperatures up to 200°F.

Other features are total immersion of cylinder in solution, no parts other than neoprene rubber and "H-T Sincolite" are exposed to the solution, easily interchangeable pulleys vary the speed of cylinder revolutions.

The new barrel is offered in all standard sizes and in multiple units. Complete construction and performance details are presented in the firm's new Bulletin GSB-101 now available from the manufacturer on request.

Dual Purpose Respirator

Chicago Eye Shield Co., Dept. MF, 2300 Warren Blvd., Chicago 12, Ill.

A dual purpose respirator, with twin cartridges for organic vapors or filters for dust has just been announced.

The facepiece of this respirator is contoured of soft rubber to provide snug, comfortable, leakproof fit even with light tension on the two adjustable headbands.

As No. 99 Respirator, for organic vapors, it has twin 85cc cartridges with inhale and exhale check valves to prevent rebreathing. Cartridges are quickly replaced from front by unscrewing retainer caps. As No. 96 Respirator, for dusts, it has twin treated wool-felt filters with high filtration factor. Because there are no outer screens or covers over filters, entire surface area of each is usable, thereby prolonging filters' life and reducing breathing resistance. Filters are quickly replaced from front same as on No. 99.

CrO_3 Chromic Acid

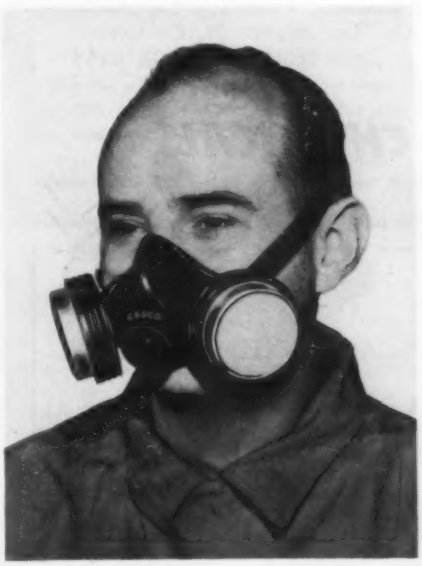
for DECORATIVE PLATING
HARD CHROMIUM PLATE
ANODIZING ALUMINUM
CHEMICAL CONVERSION COATINGS
STRIPPING COPPER
METAL CLEANING BATHS
ORGANIC SYNTHESIS
MANUFACTURE OF CATALYSTS

● The Mutual name and trade mark on a Chromic Acid drum guarantee a product with a minimum assay of 99.75% and a sulfate content not exceeding 0.1%. Chromic Acid of that purity may be used with confidence in any of the above applications.

MUTUAL CHEMICAL CO. OF AMERICA

SINCE 1845 270 Madison Avenue New York 16, N. Y.

Plants: Baltimore - Jersey City



This dual purpose respirator is economical because it reduces inventories of parts. It is necessary to buy only one complete respirator plus other elements desired.

Barrel Finishing Compound

Minnesota Mining and Manufacturing Co., Dept. MF, 900 Fauquier St., St. Paul 6, Minn.

A new multiple purpose barrel finishing compound said to produce brighter finishes in less time on a very wide range of metals has recently been introduced.

Called "Honite" brand Multi-Burnish compound, it can be used for burnishing operations where three or four conventional compounds were previously required. In addition, it

Reduce costs in your paint department with these Wyandotte products!

Here's a complete line of versatile, low use-cost Wyandotte cleaners, paint strippers, rust removers and spray booth products to give you the best start for finer finishes:

PRE-FOS* — Cleans steel and nonferrous metals *and* deposits a fine-grained phosphate coating . . . provides an excellent base for paint and greatly increases corrosion resistance. PRE-FOS is nonhazardous and gives outstanding performance at low cost.

INDUSTRIAL NO. 38 — An alkaline cleaner for use in spray washers on all common metals except aluminum. Contains no wetting agents or soap — will not foam excessively in the highest pressure washers. INDUSTRIAL NO. 38 is a balanced formula for maximum detergency in removing shop dirt and fabricating soils.

P-1075 — An organic, solvent-type paint stripper for immersion use. It is safe on all metals, has good rinsability, and contains a buffered seal to prevent evaporation of solvents.

NORDALL* — Provides maximum emulsion detergency for metal parts, with minimum material cost, in pressure spray washers. Also inhibits rust on ferrous metals. It is noncorrosive, nonfoaming, nonflammable and nontoxic under normal conditions. NORDALL, with very low volatility, has long life.

PHOS-IT — A liquid, acid product which removes light soils, rust and oxides, and conditions steel, zinc and aluminum alloy surfaces for painting. It is a concentrated, all-purpose detergent, rust remover and metal conditioner. PHOS-IT provides excellent paint adhesion, and increases corrosion resistance.

MERSOSTRIP — An *accelerated, complete* alkaline paint remover which completely strips most finishes in record time. Speeds recovery of rejected parts, and cleans hooks, racks and conveyor equipment rapidly. Nontoxic MERSOSTRIP saves production time, man-hours and dollars.

444-C—A quick, nonflammable, brush or flow-on, organic paint stripper for all metal and wood surfaces. Excellent for large parts or equipment which cannot be stripped by immersion. Penetrates multiple coats of most finishing materials with a single application . . . clean, bare surfaces are attained with minimum expense and labor.

FLOTE — A *new* and *different* product that effectively prevents sinking paint sludge and clogging in water wash spray booths . . . eliminates tackiness and back-wall build-up. FLOTE handles *all* organic finishing materials, while cutting operating problems and slashing maintenance costs.

HEDRAL — Prevents adhesion of all types of finishing materials to dry walls of spray booths. HEDRAL is easily sprayed on, does not dry out, and allows removal of overspray in continuous sheets without scraping. It is nontoxic, nonflammable — promotes good housekeeping, minimizes fire hazard.

*REG. U.S. PAT. OFF.

Call your local Wyandotte representative, or mail the coupon today, for technical data on these Wyandotte products. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Angeles 12, California.*

Wyandotte CHEMICALS

REG. U. S. PAT. OFF.

Helpful service representatives in 138 cities in the U. S. and Canada

Largest manufacturer of specialized cleaning products for business and industry

Wyandotte Chemicals Corporation
Department 2198, Wyandotte, Michigan

Please send free technical information on:_____

☐ Please have a representative call.

Name_____

Firm_____

Address_____

City_____ Zone____ State_____

can be used with all types of barrel finishing media. As a result, reductions in burnishing costs up to 50% are possible using the versatile new compound, according to the company.

During the first part of the operating cycle, the new compound acts as an effective cleaner and permits rapid deburring. It then develops progressively richer suds which act both as a lubricant and as effective suspending agent, resulting in high luster and brilliant color to the work pieces.

Among the advantages of the compound are:

(1.) It can be used with almost any metal and is especially recommended for use with zinc, aluminum, magnesium, bronze, and mild and stainless steel.

(2.) It can be used with all types of barrel finishing medium such as steel balls, natural stones, or aluminum oxide barrel finishing chips.

(3.) It will not break down and lose its lubricating qualities even over prolonged runs.

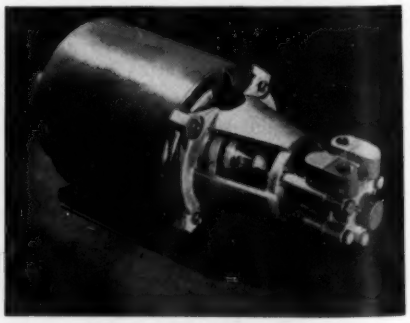
(4.) It is completely soluble, making for free rinsing and producing parts with high luster and clean surfaces.

From one to two pounds of the new compound — which comes in 100-pound containers — are sufficient for the average 16-inch by 30-inch compartment with full loads.

Firms engaged in barrel burnishing can obtain free demonstrations of the new compound under competent personal supervision of company sales engineers by writing the manufacturer.

Compact Pump-Motor Unit

Eco Engineering Co., Dept. MF, 12 New York Avenue, Newark, N. J.



The above manufacturer announces a new close-coupled pump motor unit which requires no outboard support or special alignment.

A unique pump mount which fits the new General Electric fractional

horsepower motors and bolts directly to the motor housing accomplishes this advantage — and the unit, therefore, saves valuable space and expense in many devices and appliances where streamlined cabinet proportions are a factor.

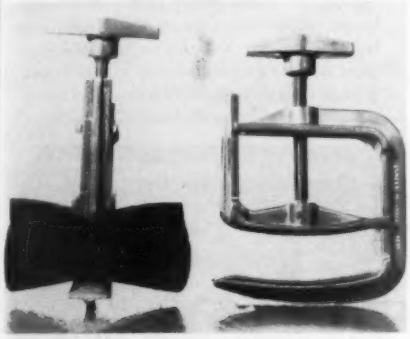
The pump is a standard, widely used Eco pump of positive displacement type with 2 opposed, axially-oscillating impellers equivalent to duplex piston action, providing continuous, non-surge flow. Features are:

Pressures to 150 p.s.i. Various capacities up to 10 G.P.M. High suction lift. Self priming. Non-foaming. No air entrainment.

Impellers are of synthetic rubber, plastics, Teflon, Hypalon, Monel, and porous metals for all requirements.

Hose Valve

Carl Buck & Associates, Dept. MF, P.O. Box 267, Essex Fells, N. J.



The valve, because of contoured design, will not damage hose and will give a complete shut-off against pressures up to 100 p.s.i. Its light weight places a minimum of drag on the hose. One hand operation is possible and the valve may be put on or taken off hose runs without disturbing connections.

The valve is made of aluminum and bronze so that it will not rust even if exposed to the weather, and is suitable for use with hose from 1" to 2½" ID.

High-Volume Blower

Standard Electric Mfg. Co., Inc., Dept. MF, West Berlin 12, N. J.

A large-capacity blower (6-inch wheel) for quick removal of fumes, smoke, and stale air, or for cooling and ventilating, is now being offered. Moving up to 600 cubic feet of air per minute, the blower features an automatic cutout which stops the completely enclosed 110-volt 60 cycle motor before it can overheat.

Smaller sizes with different capacities and current characteristics are also available.

3-in-1 Honite Compound cuts burnishing costs up to 50%!

"Multi-Burnish" can be used with almost any metal, and with all types of barrel finishing media. It is completely soluble, making for free rinsing. Parts *always* come out with a high luster and clean surfaces.

New HONITE "Multi-Burnish" can *cut your burnishing costs in half* because it does the work of three or four ordinary barrel-finishing compounds, *and* produces brighter surfaces faster than ever before possible!

Here's why . . .

1. During the first part of its operating cycle, HONITE "Multi-Burnish" is a powerful cleaner that deburrs rapidly for 20 to 40 minutes.

2. In its second phase, "Multi-Burnish" Compound develops progressively richer suds which act both as a lubricant and a suspending agent, resulting in high luster and brilliant color on the work pieces.

WRITE TODAY for FREE demonstration in your plant of HONITE "Multi-Burnish" Compound

Honite®
"CLEAN CUT" COMPOUND

"Clean-Cut" is a rapid, clean-working surface cutter which has the extra advantage of being a semi-burnishing compound. Too, it will not darken the surface of light metals.

Honite®
"SPEED CUT" COMPOUND

"Speed-Cut" is one of the fastest-cutting of all abrasive compounds —contains an abrasive which is next to diamond in hardness. "Speed-Cut" may be used with chips or in a self-tumbling process.

YOUR HONITE DISTRIBUTOR has a complete line of compounds to meet your every barrel finishing need. He'll be glad to work with you to find the *right* compound for your job . . . and develop special compounds if necessary.

Honite® BRAND

Made in U.S.A. by Minnesota Mining and Mfg. Co., St. Paul 6, Minn.-also makers of "Scotch" Brand Pressure-Sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: 122 E. 42nd St., New York 17, N.Y. In Canada: London, Ont., Can.

3M

Minnesota Mining & Mfg. Co.
Dept. MF-24, St. Paul 6, Minn.

☐ Yes, I'd like a FREE demonstration of HONITE "Multi-Burnish" Compound.

☐ Send me free copy of booklet "Barrel Finishing Manual" which contains complete information about HONITE barrel finishing compounds.

Name.....Title.....

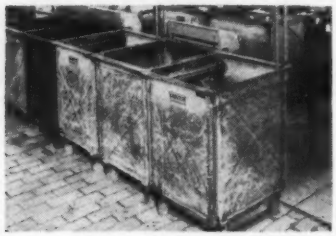
Company.....

Address.....

City.....Zone....State.....

PLA-TANK® TANKS

Built in One Piece to Stay in One Piece



Strong, lightweight Pla-Tank Resin-Bonded Glass Laminate Tanks are now — and always have been — molded in one piece. Several years ago we started making tanks over a mold after our engineers recommended this as the best production method. Since then, our customers have been telling us that you can't beat one-piece construction.

Frankly, we could assemble sheets and corners for less money — but we sincerely believe they'd be worth lots less as a tank.

One-piece PLA-TANK tanks take more abuse . . . last longer. There's no chance of coming apart at the seams. And PLA-TANK gives you a homogeneous tank wall as opposed to tanks with varying resistances due to adhesives used in the corners. Personal attention during manufacture to each square inch of surface insures against weakening dry spots and brittle resin build-ups.

269 STANDARD SIZES AVAILABLE

Even though individual molds are used, we can offer 269 standard sizes of cylindrical and rectangular tanks . . . all available for quick delivery without mold charges!

You can be sure of better, longer service with PLA-TANK — the FIRST name in Chemical Resistant Laminates.

Write for free data file sheets

THE Chemical CORPORATION

58 Waltham Ave., Springfield 9, Mass.

Washing Compound Concentrate

Ipsen Industries, Inc., Dept. MF, 715 S. Main St., Rockford, Ill.

A new, non-corrosive, ferrous metal washing compound for quick, thorough removal of quenching oils after heat treating has been announced. The new product, Ipsen Washing Compound 103, is designed for effective removal of oil, grease, lubricants, soils, lapping and drawing compounds.

Suitable for both batch and spray type washers, the degreasing agent will produce metallurgically clean work pieces within 3 to 10 minutes in circulating-type washing equipment. Quickly penetrating oil and grease, surface action removes and floats away impurities, and parts dry bright and clean, without residue. Longer lasting washing efficiency is obtained with this metal cleaning product because soil particles are never held in solution, and the solution remains at an effective level longer. Foaming characteristics of the compound are controlled to give optimum degreasing.

Although only mildly alkaline, it will remove such "heavy soils" as drawing and buffing compounds, and other heavy oils and greases. Non-caustic, the new compound is mild and will not harm skin or clothing. Safe for metal surfaces, it will not corrode or etch finished metal parts. Because it is odorless and non-toxic, special ventilation is not required.

The degreasing agent is a fine, granular mixture of alkaline materials combining detergents and surfactants. Quick "wetting" and fast soil penetration action reduces washing time and, on normal jobs, eliminates any need for pre-soaking. A modified Compound 103, designated Metal Washing Compound 107, provides increased solubility and is available for certain unusual conditions sometimes found in use of spray type equipment.

Because it is concentrated, less than one ounce of the washing compound per gallon of water provides an efficient degreasing solution for either batch or spray type washers. Tank charging is simple and easy with only 18 pounds needed to charge a 250-gallon tank, as compared to 75 and 90 pounds of ordinary non-concentrated compounds. Compound 103 is available in bulk quantities and is also packed in handy "load-size" 18 pound polyethylene packages which simplify stocking, handling and avoids tendency to overcharge.

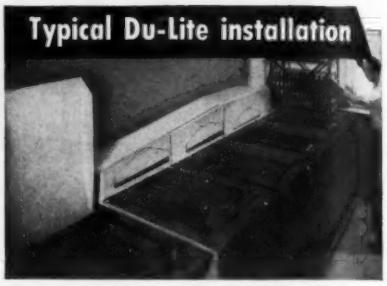
On any steel blackening problem

DEPEND on DU-LITE for a Superior Finish

Courtesy The Poly Choke Co.

Du-Lite gave this part with its complicated knurls, slots, threads, etc. a fine rust-resistant durable black finish. It is typical of many other parts, small and large, which have been black oxidized by Du-Lite for many years. Moreover, Du-Lite meets most individual and government specifications including 57-0-2C for Type III Black Oxide finish.

Typical Du-Lite installation



Du-Lite installations are simple, compact, easy to operate. Du-Lite equipment can be tailored to fit production requirements on all types of jobs with a maximum of speed and economy. Du-Lite also makes a complete line of cleaners, strippers, wetting agents, passivating agents, rust preventatives, burnishing compounds etc. for any metal finishing application.

See your nearest Du-Lite Field Engineer or write for more information.

DU-LITE CHEMICAL CORP.
MIDDLETOWN, CONN.

Rush information on your metal finishing products.

Name.....
Company.....
Address.....
City..... Zone..... State.....

Du-Lite
METAL FINISHING SPECIALISTS

LETTER TO THE EDITOR

Mr. Nathaniel Hall
Finishing Publications, Inc.
381 Broadway
Westwood, New Jersey

Dear Mr. Hall:

Considerable interest in the use of sequesterants in aluminum etching has been aroused since our paper appeared in the October issue of METAL FINISHING.

Additional information, which should have been included in the paper but only came to our attention after the paper was published is abstracted below. We are wondering whether you can inform your readers of this information through the "Letters to the Editor" section since they will find it of great value in any studies they may plan.

U. S. Patent No. 2,650,875 describes a method for etching aluminum and aluminum base alloys. The process claimed consists of treating aluminum articles with certain compositions containing caustic and various polyhydroxy compounds including the gluconates. This patent has been assigned to the Diversey Corp.

U. S. Patent No. 2,653,861 reports on etching aluminum with hexahydroxyheptanoic acid (glucoheptonic acid) as a modifier. The patent claims aluminum etching compositions containing a soluble salt of this acid with an alkaline substance. It also claims the process of etching with these compositions. This patent has been assigned to Enthone, Incorporated.

If you have any further questions regarding the information I have outlined above, please feel free to call on me.

Very truly yours,
F. J. Prescott
Manager, Industrial Section

BUSINESS ITEMS

Rapid Electric Appoints Ardco

The *Rapid Electric Co.*, 2881 Middletown Rd., Bronx, N. Y. has announced that *Ardco Inc.* of 5000 W. 73rd St., Chicago, Ill. has been appointed as their exclusive direct factory representatives in the metropolitan Chicago area.

Ardco will supervise all aspects of the distribution of Rapid's selenium rectifiers and maintain a full inventory. Included are rectifiers which are now on display for the convenience of purchasing agents and shop foremen who are interested in viewing and inspecting the latest advances in plating rectifiers.

Wallace & Tiernan — Novadel Agene Merger Announced

Martin F. Tiernan, chairman of the board, announced that on January 1, 1954, the merger of the associated companies, *Wallace and Tiernan Co., Inc.* and *Novadel-Agene Corp*, into a single organization known as *Wallace & Tiernan, Inc.*, was completed. Stock of the new company is listed on the American Stock Exchange. Subsidiaries include W. C. Hardesty Co., Inc., Richmond Manufacturing Co., Thomson Machine Co., Electro Rust-Proofing Corp. (N.J.) and Wallace and Tiernan, Ltd.

The new company's principal lines of activity include: Wallace & Tiernan chlorinators, water purification apparatus, chemical feeders and materials handling equipment, processes for treating fresh produce, electrical specialties, lighthouse equipment, precision pressure sensitive instruments and ethical pharmaceuticals; Novadel organic peroxides and equipment and Electro Rust-Proofing cathodic protection services.

Wallace & Tiernan is best known in the water treatment field through its chlorinators and chemical feeding equipment, which have been used by municipal water works, sewage and waste treatment plants and industrial water supplies for over 40 years.

Principal plants are located at Belleville, N. J.; Buffalo, N. Y.; Genesee, N. Y.; Dover, Ohio; Toronto, Canada; and London, England.

Industrial Ventilation Conference

The Third Annual Industrial Ventilation Conference to be held at the Kellogg Center, Michigan State College, East Lansing, Mich., on February 22-25, 1954, is sponsored jointly by the School of Engineering, Michigan State College, and the Division of Occupational Health, Michigan Department of Health, with the assistance and the cooperation of industry including equipment manufacturers, contractors, and plant engineers. As in the past, this course will take the form of general assembly meetings, demonstrations, and small group class sessions for the purpose of practicing and illustrating the principles involved in industrial ventilation.

Beckman Expands Field Service

Five new field repair specialists have been assigned headquarters in the U. S. and Canada by *Beckman Instruments, Inc.*, national manufacturer of instruments for science and industrial process control.

The service men, all qualified electronics maintenance experts, will conduct on-the-spot servicing of Beckman equipment in laboratories and industrial plant installations. Their assignment follows an intensive 12-week factory training course in California.

Service headquarters are located at Los Angeles, Calif., Washington, D. C., Mountainside, N. J., Houston, Texas, and Toronto, Canada.

Pennsalt Chemicals Consolidates Personnel and Public Relations Activities

George B. Beitzel, president of the *Pennsylvania Salt Mfg. Co.*, has announced the consolidation of its personnel and public relations activities under the direction of *Fred C. Abbott*, manager of personnel and labor relations since 1947. The redesignated office will be known as the office of industrial relations. Mr. Abbott, a chemical engineer, was graduated from the University of Arkansas and came to Pennsalt in 1943. He attended the advanced management course of Harvard Graduate School of Business Administration in 1950. His staff will serve nine plants and numerous sales offices of the parent company and its three subsidiaries.

Concurrently *Dr. W. Austin Bishop*, director of training and employee publications, was named manager of public relations. He will succeed *Cleveland Lane* who recently resigned to accept a similar position with the Manufacturing Chemists' Association, Washington, D. C.

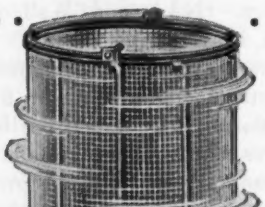
Dr. Bishop joined the 103-year-old manufacturers of industrial, agricultural and special chemicals in 1950 following a three-year public relations assignment in Department of Army Headquarters, Washington. He is a graduate of Franklin & Marshall College and did post-graduate work at New York University. From 1936-1942 he was a member of the faculty and athletic staff of the University of Pennsylvania, and after World War II returned to his alma mater as Di-

DRIES SMALL PARTS Faster–Better..

DOES IT FOR LESS!

Kreider Dryer with auxiliary gas heating unit (illustrated). Auxiliary steam heating unit available; also standard model without auxiliary heating.

Basket (shown below). Heavy gauge steel woven mesh over steel frame. Capacity, 1140 cu. ins.



Spin-Dries* up to 50 pounds in less than 2 minutes

Simple design . . . careful engineering, sturdy construction assure trouble-free, low-cost maintenance operation. Operates at 625 r.p.m. on less than 1 h.p.

No scarring or marring . . . with Kreider Dryer. Centrifugal force holds parts immovable in basket . . . assures smooth, evenly dried surfaces, long-lasting luster, minimum "rejects".

One man runs it! Standard model Kreider Dryer occupies less than 6 sq. ft. floor space. One man tends—loads, unloads—keeps production moving, prevents expensive, time-wasting tie-ups.

See for yourself! Write Department ME24. for illustrated 4-page folder . . . also addresses of installations near you.

New Holland Machine Co., New Holland, Pa.

***Only 2 simple steps required . . .**

(1) Operator places wire mesh basketful of small parts in Dryer . . . turns motor "ON."

(2) Operator turns motor "OFF" . . . presses foot brake . . . removes basket.

NEW HOLLAND *KREIDER* DRYER

rector of Athletics. Active still in military affairs, Dr. Bishop holds a reserve commission in the grade of Colonel and is a member of the staff of the Philadelphia U.S.A.R. School.

H-VW-M President Honored on 25th Anniversary

At a Dec. 22 dinner at the University Club in New York, *Louis M. Hague*, president of *Hanson-Van Winkle-Munning Co.*, Matawan, N. J., was presented with a gold watch by his fellow directors and a pair of silver candelabra by the corporation in commemoration of 25 years with the firm, which engineers and manufacturers equipment and supplies for the metal finishing and metal plating fields. The presentation was made by *Van Winkle Todd*, chairman of the board, and was attended by board members.

Mr. Hague started with H-VW-M in 1928 as a salesman out of the Pittsburgh office. Prior to joining the firm, he had completed nearly 12 years in the industry, starting as an apprentice in his father's job plating shop. Both his father and grandfather were in the plating field, specializing in silver work.

In 1929 Mr. Hague became district manager of the Cleveland office and in 1930 assistant Eastern sales manager. From 1932 to 1935 he handled special sales assignments in various offices. In 1935 he was put in charge of polishing sales and services and in 1939 became sales manager, vice-president and director. He was elected president in 1948.

Mr. Hague's other activities include membership in the *American Electroplaters' Society;* American Ordnance Association; Presidents Council, American Institute of Management; Industrial Brush Section of WPB (World War II); and Primary Consumers of Nickel for Chemicals and Electroplating Industry Advisory Committee (present). He is a World War I veteran, and a former Mayor of Rumson, N. J.

Van Winkle Todd, at left, presenting watch to Louis M. Hague.

New Company Formed by Originators of Bias Sisal Buff

Bias sisal buffs will now be available to the metal finishing industry in larger quantities than ever before, as a result of the recent formation of *The Joe-D Buff Company*, Sandwich, Ill. This new source makes possible wider distribution through more jobbers, bringing the benefits of this popular type of buff to more buff users.

The new company, holders of the original patent on the bias sisal buff (U. S. Patent No. 2,642,706), combines the assets and interests of two former Chicago firms: *Joseph R. Davies & Associates* and *Dearborn Industrial Mfg. Co.* They have assembled a thoroughly-experienced staff, including some of the top "know-how" in the industry, and the large, modern plant in Sandwich is already in full production. With this additional capacity and personnel, output of bias sisal buffs has been substantially increased.

The complete Joe-D Buff line includes not only bias sisal buffs, but also bias, bias spoke ("finger"), and conventional buffs, as well as polishing wheels of all grades and constructions, for every metal finishing purpose.

Distribution of the buffs is primarily

through jobbers, and several good territories are still available. For particulars, write to the company.

Richdale Becomes President of Engelhard Industries Group

Charles W. Engelhard, chairman and general manager of the companies composing the *Engelhard Industries Group*, announced that he had relinquished his duties as president and that *Gordon V. Richdale* had been elected to that position, effective January 1.

Mr. Richdale comes to his new position after fourteen years in the gold mining industry of South Africa where he was a director of the Rand Mines Group. He organized the Harmony Gold Mining Co., Ltd., in 1949, becoming its first chairman and managing director; and he held the same positions with City Deep Ltd., East Rand Proprietary Mines Ltd., Central Mining Free State Areas Ltd., Exchange Yard Proprietary Ltd., Transvaal Gold Mining Estates Limited, and South African Forest Investments Ltd. Collateral interests included directorships in companies producing cement, coal, wire rope and boxes.

Udylite Opens Warehouse in Rockford

L. J. George, Chicago district manager of the *Udylite Corporation*, has announced the opening of a new warehouse in Rockford, Ill., to be under the direct supervision of *David B. Stockton*, resident sales engineer.

The warehouse at 310 Market St. is amply stocked with metal plating and finishing supplies. Firms in the area were formerly serviced from the Chicago factory.

David B. Stockton

The Rockford warehouse is the ninth to be opened in the corporation's nation-wide expanison program.

Divine Brothers Co. Appointments

Effective December 1, 1953, *Charles Lamb, Jr.* was appointed treasurer and general manager of the *Yerges Mfg. Co.* of Fremont, Ohio. This company manufactures a well known line of polishing and buffing wheels, having originally been the home of the square sewed buff, and is a subsidiary of *Divine Brothers Co.* of Utica, N. Y.

Mr. Lamb has been associated with Divine for the past nine years in various capacities, and was more recently sales manager of Metal Finishing Products Department.

Before joining Divine, Mr. Lamb was associated with the Western Electric organization.

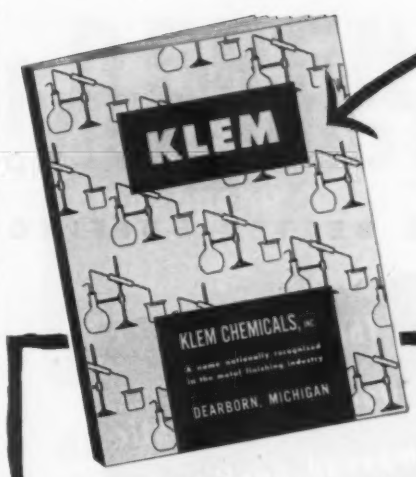
Frederick H. Thompson has been appointed manager, Central Division, Metal Finishing Products Department. He will be located in Ohio and will operate in the Midwest.

Thompson has been associated with the company since 1927. For the past 10 years he has operated the Yerges Manufacturing subsidiary.

With his new assignment he will be able to devote his time exclusively to Divine.

Dr. George Dubpernell Honored

Dr. George Dubpernell, manager of the Waterbury Laboratories of *United*



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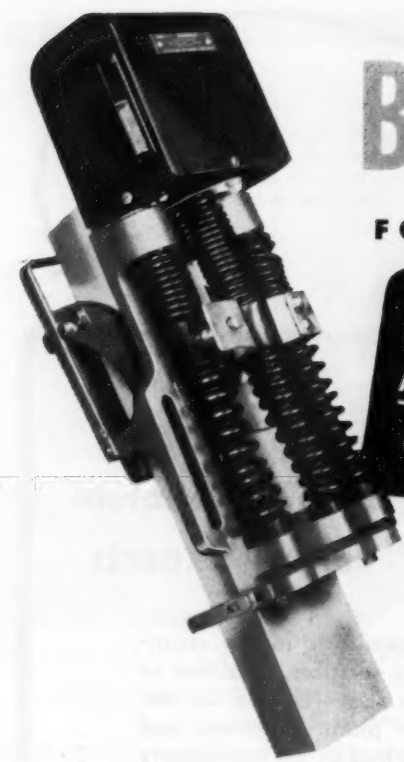

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The Nankervis Air-Operated Automatic Compound Applicator

X STROKES PER MINUTE

(X . . . The number of strokes *your* buffing operation calls for—indexed by work, platen, electric timer, foot switch, cam, etc.)

You, too, can cash in on all of the advantages of automatic compound application—earn substantial savings in material and time; have a cleaner buffing department as well.

The Nankervis air-operated automatic compound applicator provides all of these advantages and more!

Because it is flexible, you use compound only when it's needed. The number of times the compound actually touches the wheel depends upon the buffing operation involved. *That, alone, adds up to real savings.* The applicator is actuated either mechanically, electrically or manually; feeds just the right amount of compound; not too much, not too little.

It's ideal for multiple operation, too. All the applicators on an entire buffing line can be operated simultaneously from a single three-way valve.

The entire story is contained in the new Nankervis booklet covering the air-operated compound applicator. Write for Bulletin No. 6-600—*today!*

Nankervis COMPANY

EQUIPMENT AND SUPPLIES FOR THE METAL FINISHING INDUSTRY

19255 WEST DAVISON AVENUE • DETROIT 23, MICHIGAN

Dr. George Dubpernell, manager of the Waterbury laboratories of United Chromium, accepts watch presented to him by President Richard O. Loengard in honor of Dr. Dubpernell's entry into the Twenty Year Club of United Chromium.

Chromium, Inc. and one of the leading authorities in the field of electroplating was honored at a luncheon at the Hotel Barclay in New York November 19. The celebration marked Dr. Dubpernell's admission to membership in the Twenty Year Club of the firm.

Dr. Dubpernell is best known for his contributions, many of which are patented, in the chromium plating field. He was co-inventor of a chromium plating barrel which has gained wide aceptance as an improved means for economical chromium plating of small parts. Through his many articles, papers, and book reviews, Dr. Dubpernell has become an internationally recognized authority on electroplating. He has also assembled one of the world's best private libraries on electroplating.

More than half of Dr. Dubpernell's books are collectors' items, some being more than 100 years old. The library, started in 1920, now contains about 500 books on plating and related subjects printed in English, German, French, Italian, Spanish, Russian, Dutch, Swedish, and Norwegian. His library also includes unusually complete sets of technical periodicals and also originals or photostatic copies of practically every paper, article, or patent on the subject of chromium plating published prior to 1935 and the most important material published since that date.

Dr. Dubpernell was graduated in 1924 from the University of Michigan where he was associated with Professor E. M. Baker. He then worked and studied under Dr. Colin G. Fink at Columbia University, receiving the A.M. degree from that institution in 1927. Returning to the University of Michigan, he studied under Professor A. L. Ferguson and earned the Ph.D. degree in 1933 for work on overvoltage.

In attaining membership in the Twenty Year Club of United Chromium, Dr. Dubpernell joins many others closely associated with the development of chromium plating. He was presented with an engraved watch to commemorate the occasion.

International Nickel Sales Appointments Announced

J. M. Weldon has been transferred to the General Sales Department of *The International Nickel Co., Inc.*, as assistant to the vice-president, according to *W. C. Kerrigan*, general sales manager.

In other appointments, *C. J. Bianowicz* has been named manager of the Nickel Alloys Department, and *Daniel W. Machon* has been placed in charge of the newly established Cobalt Section of the Nickel Sales Department.

Mr. Weldon, in his new position, will deal principally with the company's mill and foundry products. Associated with the company since 1927, he has held various assignments in the sales, executive and other departments.

Mr. Bianowicz, who succeeds the late *H. D. Tietz*, previously was in charge of the I.N.A. Department's industrial sales. He joined the company in 1928 as a salesman in the depart-

ment he now heads, and last August 1 completed 25 years' service with the company.

Mr. Machon joined the firm in 1949 as a representative abroad, serving in this capacity until March 1, 1952, when he returned to New York. He was in the secretary's office prior to his present appointment.

New Distributing Firm

The Gerell Mfg. Co. announces the establishment of the *Stanley Supply Co.* for the distribution and sales of buffing and tumbling supplies. The plant, warehouse and offices are located at 5208 Sweeney Ave., Cleveland 27, Ohio, Broadway 1-1733.

Jason Heads Milwaukee District Office for Sipi Metals

Al G. Jason, it is announced by *Maury E. Lippert*, vice-president in charge of sales of *Sipi Metals Corp.*, Chicago 22, Illinois, has been named district manager with offices at 3535 W. Verona Court, Milwaukee 15, Wis.

Mr. Jason, a native of Milwaukee, who has been active in the non-ferrous metal field for the past 15 years, has been associated with Sipi for the past 6 years and is well known throughout the industry.

New Finishing Equipment Firm

A new corporation, *The G. S. Equipment Co.*, 5317 St. Clair Ave., Cleveland, Ohio, has been organized to serve the metal finishing industry with new equipment of its own design and manufacture as well as other national makes according to *T. R. Gill*, vice-president and general manager.

It was organized by the officers and directors of *The General Supply Co.*, same address, and will take over all equipment sales formerly handled by that firm. The General Supply Co. continues to serve the metal finishing industry with supplies only.

T. R. Gill

The new corporation is reported to be developing many new units of equipment, one of which is said to be a plating barrel of revolutionary design slated for introduction at an early date.

Permutit Expands Manufacturing Facilities

The Permutit Company, New York, makers of all types of industrial and commercial water conditioning equipment and ion exchange resins, is building a modern metal-working plant at Lancaster, Pa.

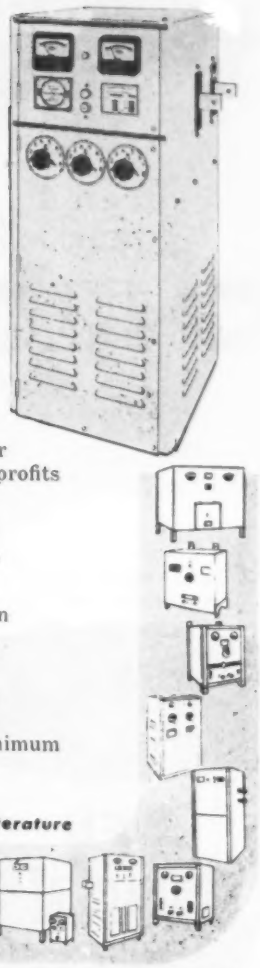
With the foundations in and most of the steel-work installed, it is scheduled for completion by the spring of 1954. The new manufacturing plant will cost about $750,000 and will occupy 2 acres on a site of approximately 30 acres. The plant will be of modern design, with all facilities on one floor. The consolidation at Lancaster of two similar activities in plants at Brooklyn, N. Y. and Philadelphia, Pa., will effect substantial economies.

According to *H. W. Foulds*, president, the firm expects to vacate the Brooklyn, N. Y. plant early in 1954 and transfer its equipment, augmented by new production apparatus to the new location as soon as possible. Later in the year, the manufacture of Sim-

DEPENDABLE

RICHARDSON ALLEN RECTIFIERS

an unfailing D-C SUPPLY for quality plating



For increased production, improved quality, fewer rejects, lower labor costs—which translates into higher profits—use Richardson-Allen dependable rectifiers.

The basic R-A Rectifier is widely used where a single voltage or current is needed or where several rectifiers are to be paralleled.

For electroplating chrome or bright nickel a 22-position tap switch is supplied. For electroplating gold or silver, and for anodizing a 36-position tap switch is used.

A special Heat Exchanger unit is available for use in corrosive atmospheres. This R-A development permits operation at elevated ambient temperatures with a minimum temperature rise. Long, uninterrupted, dependable service is assured.

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Only a few years ago we were new comers to the Chromic Acid business. Since then we've shipped quite a few million pounds . . . and made a lot of good friends, too.

We think you will like the quality of our products and the fair way we do business. Why not send us a modest order and judge for yourself? That's the simple way our present customers got started with BFC Chromic Acid.

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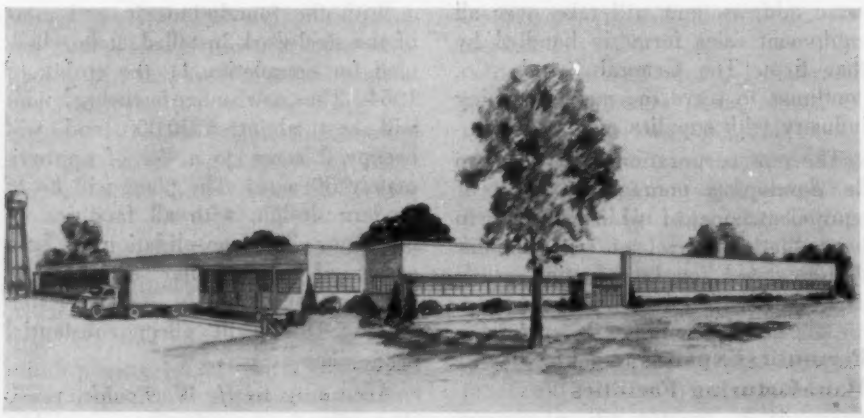

plex Valve & Meter Company products, now produced in Philadelphia, Pa., will also be transferred to Lancaster. Neither the main executive and sales office at New York, nor the manufacturing plant at Birmingham, N. J. will be affected by this expansion move. Long-range plan provides for the full and continued use of the Birmingham property.

R. J. Colvin Wins Award for Service

John A. Carter, president of *Oakite Products, Inc.*, presented the 1953 D. C. Ball Award to *R. J. Colvin*, Syracuse, N. Y., representative of the firm, one of the nation's leading manufac-

turers of industrial cleaning and related materials.

The award, presented annually in memory of the firm's founder to the company representative who has rendered exceptional service to industry, was made at the regional technical-sales conference held at New York's Roosevelt Hotel in December.

National Research Consolidates Equipment Division

All functions and departments of the Equipment Division of *National Research Corp.* are now located at the division's manufacturing plant at 160 Charlemont St., Newton Highlands 61, Mass., according to an announcement by *Harold C. Weingartner*, vice-president and general manager of the division. By thus bringing sales, engineering, product development, and manufacturing activities together at one location, more efficient operations and better customer service will be possible.

The N.R.C. Equipment Division specializes in high vacuum equipment, including diffusion and mechanical vacuum pumps, vacuum gauges, coaters, furnaces, and other high-vacuum process equipment.

In addition to Mr. Weingartner, other key personnel of the division who will be located at Newton are: *S. S. Minault*, manager of engineering, *Leo R. Calzini*, production super-

intendent, and *Walter G. Overacker*, manager of equipment sales.

The telephone number of the Equipment Division in Newton is DEcatur 2-3300.

Cambridge Wire Cloth Appoints Carmean

Richard C. Carmean

The Cambridge Wire Cloth Co., Cambridge, Md., has announced the appointment of *Richard C. Carmean* to its sales engineering staff. Mr. Carmean will assist *Fred L. Stevenson* in sales and service work in the Ohio-Michigan-Eastern Indiana territory. This new appointment will provide this important industrial area with broader direct factory service on the industrial wire cloth, wire mesh conveyor belts and metal fabrications manufactured by the firm.

New Diversey Field Service Representatives

New D-Men, field service representatives of *The Diversey Corporation*, who have just completed an intensive technical and sales training course and are now in the field selling the firm's pre-finishing cleaners to the metal industries:

Back row (l. to r.) *W. O. Schmidt* (Central Division); *J. O. Hillock, Jr.* (Central Division); *R. S. Sweeney* (Central Division); *A. J. Babinski* (Eastern Division); *W. G. Polzin*, assistant to the manager; *P. L. Moltzau* (Central Division); *R. W. Dinsmore* (Central Division).

Front row (l. to r.) *J. H. Palmer*, assistant to the manager; *R. L. Shannon*, manager of the Metal Industries Department; *R. R. Seelye*, instructor.

SEL-REX builds the world's largest single cubicle Selenium Rectifiers — up to 50,000 amperes — completely sealed and water cooled for absolute protection against dust, dirt and corrosion. Large single cubicle units, that will fill any D.C. power requirement, are another engineering accomplishment of the same company which originally developed completely protected rectifiers designed to withstand highly corrosive atmosphere.

There is a Sel-Rex Selenium Rectifier for every plating purpose, from 25 to 50,000 amperes. Regardless of size or type, all of them incorporate the features that make Sel-Rex the foremost name in D.C. power — top efficiency, long life and low maintenance costs, even under the most rugged plating conditions.

BART-MESSING CORPORATION

NEMA

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Pioneers and Builders of Time Tested COMPLETELY SEALED Plating Rectifiers

Without obligation, write for a copy of "Plating Power" or have our technical representative call to discuss your specific requirements.

COMING EVENTS OF THE A.E.S.

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EDUCATIONAL SESSION AND BANQUET

FEBRUARY 27, 1954

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EDUCATIONAL SESSION AND BANQUET

APRIL 3, 1954

CINCINNATI, OHIO

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NEW ENGLAND REGIONAL

EDUCATIONAL SESSION AND BANQUET

MAY 15, 1954

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41ST ANNUAL A. E. S. CONVENTION

JULY 12-15, 1954

HOTEL STATLER — NEW YORK CITY

Turco Appoints Pariseau

Appointment of *Paul R. Pariseau* as assistant to the president on special assignments was announced recently by *S. G. Thornbury*, president, *Turco Products, Inc.*, Los Angeles, Cal. His initial duties for the manufacturer of industrial chemical processing compounds will be in production matters.

Pariseau, a native of Michigan, brings to the company a great deal of "know-how," acquired in his twenty-five years' experience in the chemical industry. Soon after graduation as a chemical engineer in 1930, he became chief chemist of the W. T. Rawleigh Co. of Canada, a post he held until 1937, when he moved to Los Angeles as production manager of Pacific Chem. Co., later becoming vice-president and general manager. When Pacific Chemical was acquired by Wyandotte Chemicals Corp. in 1950, Pariseau joined Wyandotte as Los Angeles general sales manager.

Manufacturers' Literature

Rectifier Bulletin

Hanson - Van Winkle - Munning Co., Dept. MF, Matawan, N. J.

A new heavy-duty, selenium rectifier specially designed for use in plating and other metal finishing operations is pictured and described in a new bulletin ER-105. Besides combining a number of desirable features in one design, this rectifier is uniquely equipped with terminal tie-bars that permit output voltage to be changed without any change in a user's bus arrangements.

The 4-page, two-color bulletin tells what type of current and ripple is delivered by the rectifier. It gives information on models available, costs, operating capacity, various sizes the unit comes in, type of input and kind of current switching.

Instruments and parts of the unit are pointed out on large exterior and interior photographs. Individual close-ups are given of the resetting starter, calibrated thermostat, up-draft fan, custom-built selenium stacks and heavy-duty transformers.

Plastic Plating Cylinders

The Singleton Co., Dept. MF, 5317 St. Clair Ave., Cleveland 3, O.

The metal finishing industry is shown its first detailed close-up of the complete line of "H-T Sincolite" replacement plating cylinders claimed to "fit any plating barrel superstructure . . . new or old," in the colorful 4-page Bulletin RC-101, now available.

Outlined are the several features exclusive with the various models offered, all of which are "heavy-ribbed design and fusion-welded construction throughout" and made of H-T Lucite or Plexiglas.

A novel and convenient "Specifications Diagram" is inserted in the bulletin, providing the plater with a cylinder drawing on which his cylinder dimensions can be marked and returned for quotation.

Calrod Heating Catalog

General Electric Co., Dept. MF, Schenectady 5, N. Y.

A 1954 edition of the above manufacturer's catalog on Calrod electric heaters and heating devices has been announced as available.

Designated as GEC-1005E, the 60-page, two-color catalog describes the units in terms of application, special features, installation, and pricing.

More than 175 photographs and drawings illustrate the various products, including immersion, strip, cartridge, tubular, insertion, and fin heaters, melting pots, thermostats, switches, and oven heaters.

Indexed by processes and applica-

tion, the catalog also contains methods for determining power requirements and heat losses for many applications. Another feature of the publication is an index of industrial heating application bulletins, and data and specification sheets available.

Rubber Pumps, Valves and Fittings

Vanton Pump & Equipment Corp., Dept. MF, Empire State Bldg., New York 1, N. Y.

The above company has just released an informative four-page bulletin describing its Buna N and natural hard rubber pumps, valves and pipe fittings manufactured specifically for the chemical process and allied industries. Physical property and chemical resistance data is contained, together with illustrations, performance data tables and specification charts for the firm's series of corrosion resistant Buna N and natural hard rubber products.

Portable Fume Washer

The U. S. Stoneware Co., Process Equipment Div., Dept. MF, Akron 9, O.

Bulletin FW-3, just released by the above company, describes and illustrates the "Cyclonaire," the portable fume washer for low-cost fume removal in plants and laboratories.

Complete technical data, drawings, performance charts, and dimensional information on the compactly-built unit, make this a helpful booklet for all engineers concerned with fume removal problems.

Water Solids Precipitator

The Permutit Co., Dept. MF, 330 West 42nd St., New York 36, N. Y.

A well illustrated 20-page booklet, Bulletin No. 2204B, describing the many applications, principles of operation, design features, advantages, recommendations, flow diagrams, and specifications of the Permutit Precipitator in its three basic designs has been prepared and released by the company.

According to the manufacturer, the precipitator offers an efficient means of removing impurities from a liquid by precipitation, adsorption, settling and filtration. The unit requires less space, less chemicals and less reaction time than previous designs. Chief uses are in water softening, the removal of turbidity, color, taste, odor, alkalinity, silica and fluorides.

Electric Heating

Edwin L. Wiegand Co., Dept. MF, 7500 Thomas Blvd., Pittsburgh 8, Pa.

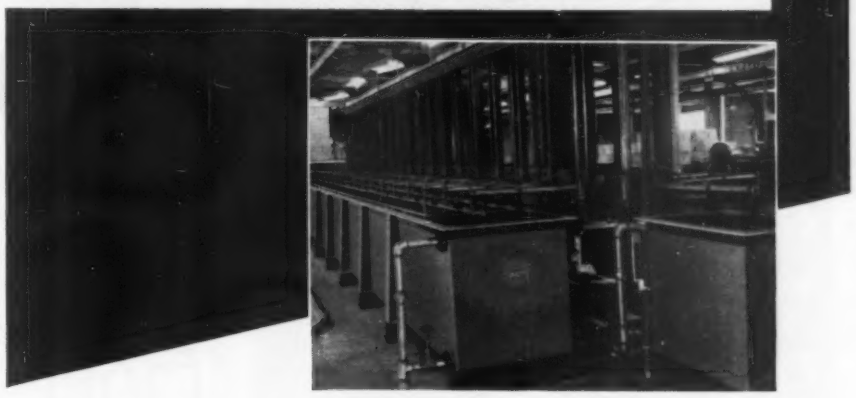
Principal industrial electric heating applications and methods are described in a new 32-page booklet, "101 Ways to Apply Electric Heat."

Illustrated case histories show experience-tested ways to apply metal-sheathed electric heating units in myriad industrial jobs. Physical aspects of installation are shown along with a description of the problem, solution and advantages obtained. Some of the heating jobs illustrated could not be done with any fuel except electricity — just as no other heat can match the job done by electric blankets.

To illustrate liquid heating, for example, diagrams, photographs and captions show why contact-type strip, ring or tubular elements are chosen — while immersion or circulation heaters are more desirable in other cases.

Similar treatment is given to problems of heating air and gases; melting soft metals and viscous materials, and heating machinery and equipment parts, such as dies, platens, molds and moving parts. Other types of heating jobs are covered by industry, and include applications in metal finishing, plastics, chemicals, foundries and electroplating. A section is devoted to far-infrared heating, showing 28 typical uses for this new method.

LONGER LIFE—MORE PROTECTION



Manhattan Rubber Linings

For complete protection against contamination of plating solutions, and for tanks that will withstand heavy duty corrosive service, manufacturers specify "Manhattan Rubber Linings."

As a result of over half a century of experience in meeting the needs of equipment manufacturers, Manhattan has developed the most dependable and economical rubber linings in the industry today. Made of calendered sheets in required thickness of non-porous natural or synthetic rubber, these linings eliminate plating "risks" and give longer, better service. In some cases, Manhattan Rubber Lined Tanks have been reported in continual use for over 25 years.

To detect any imperfections which might allow acid to penetrate the rubber, Manhattan Lined Tanks are tested dielectrically under 15,000 volts. Made to withstand the severest conditions of use, Manhattan Rubber Linings are compounded with an exclusive inseparable rubber-to-metal bond.

Depend on Manhattan's experience and leadership in rubber engineering. Specify "Manhattan Rubber Linings" to meet your most rigid requirements.

RUBBER LINING PLANTS AT PASSAIC, N. J. AND NORTH CHARLESTON, S. C.

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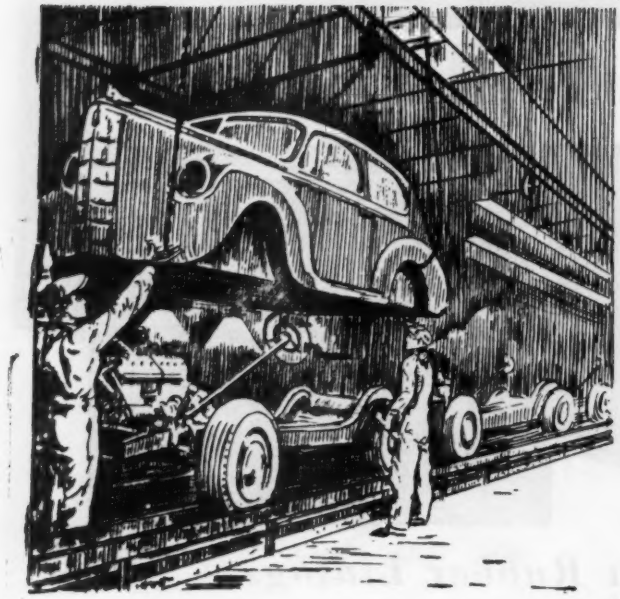
Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose Fan Belts • Brake Linings & Blocks • Clutch Facings • Packings • Asbestos Textiles • Teflon Products • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls



MOTOR CITY PLATING NEWS

Detroit Branch

The Annual Technical Session of the Detroit Branch, A.E.S., was held Friday, December 4, in the Wayne Room at the Statler Hotel. Approximately 200 members and guests were present.

President *L. C. Borchert* opened the meeting at 8:10 P.M. with the introduction of the following guests: *Dr. George Swift*, president and *Clyde Kelly*, 2nd vice-president of the A.E.S., and *P. Peter Kovatis*, managing editor of Plating. Next, the Detroit Branch officers were introduced as follows:

★ BUFFING NU SPRA GLU
Liquid buffing compound
since 1945

★ NUGLU
Cold flexible glue
since 1937

★ BRUSHING NUGLU
Grain and Nuglu mixture
since 1941

★ SPRAY BUFFING EQUIPMENT
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Plating Racks you can adjust to the job

Thinker Boy Racks are assembled from precoated members and tips. BELKE Vac-Seal Assembly seals the joints—only contact tips are exposed to the solution. Racks are easily disassembled without damage to coating.

Available as completely assembled racks or precoated rack members and tips.

Send for literature.

Effect BIG Saving

When Thinker Boy Racks for a certain job are no longer needed you can respace the members or disassemble and use the parts for other racks.

No added investment. Just order Thinker Boys when you buy racks. Instead of ceilings cluttered with no longer needed racks, you'll soon have a supply of Thinker Boy Parts — be able to assemble coated racks of your own design in a matter of minutes. Ask your BELKE Service Engineer or write for details.

Belke MFG. CO., 947 N. Cicero, Chicago 51, Ill.
EVERYTHING FOR PLATING PLANTS

Dr. William Blum, National Bureau of Standards, Honorary Chairman for the Detroit Branch A.E.S. meeting, December 4, who highlighted his recent trip to Australia.

Joe Gurski, 1st vice-president and *Lee Morse*, 2nd vice-president.

President Borchert then turned the meeting over to the educational chairman, *Fred Olmstead* who, in turn, presented the honorary chairman, *Dr. William Blum*, National Bureau of Standards.

Dr. Blum gave an illustrated talk on his recent trip to Australia with Mrs. Blum. Colored slides presented the beauty of Australia as seen through views of the country side, floral attractions, and wild life activities. Most impressive was the enthusiasm and friendliness of the Australian people shown to Dr. and Mrs. Blum. Australia has three branches of the Society with a total membership of over 500.

Dr. Blum introduced the first guest speaker of the evening, *Dr. E. J. Ser-*

Dr. E. J. Serfass, Lehigh University, who discussed recent developments in the A.E.S. research program.

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April 21-24, 1954

HOTEL RUSSELL **LONDON, ENGLAND**

Walter Pinner, Houdaille Hershey Corp., whose topic was the "Study of the New Accelerated Corrosion Tests."

Dr. A. R. Westman, Ontario Research Foundation, who discussed "The Influence of the Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating."

fass, Lehigh University, who discussed "Recent Developments in the A.E.S. Research Program."

Dr. Blum next introduced the 2nd guest speaker, *Walter Pinner*, Houdaille-Hershey Corp., speaking on Project No. 15, "Study of New Accelerated Corrosion Tests." This project is very active and papers were presented by Mr. Pinner in the Fortieth Annual Convention of the A.E.S. Results of this project can be more nearly determined in the spring when sample plated panels will be collected and evaluated after a long winter's exposure. There is a very large committee working on this project.

Dr. Blum then introduced the last guest speaker of the evening, *Dr. A. R. Westman*, Ontario Research Foundation, who discussed Project No. 4, "The Influence of the Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating." This article was also presented at the Fortieth Annual Convention of the A.E.S. Dr. Westman presented slides showing the various effects of plating on various types of steel.

A question and answer period followed in which all speakers acted as a panel.

Prior to adjournment, 2nd vice-president Lee Morse presented the research costs of the various project committees to the meeting. Approximately $65,000 per year is spent on research, and so far there has been only $5,200 contributed toward these. On the speakers platform a board depicted some 40 odd companies that have contributed toward the research projects. All contributions will be greatly appreciated and will do much to further the advancement of the various research projects.

The meeting was adjourned at 10:15 P.M. and friendship continued with the serving of refreshments.

To climax this excellent meeting.

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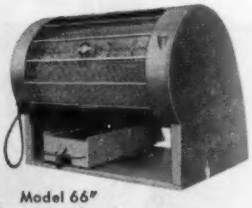

Model 66″ Two compartments

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• **Accessories.** Separator and chip grader, hoist pans, chip pans, wash-out doors, screens, chip bins, unloading boots, dip tanks.

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Standing left to right: L. C. Borchert, President Detroit Branch A.E.S.; Walter Pinner; Dr. George Swift, President A.E.S.; Dr. E. J. Serfass; Dr. William Blum; and Dr. A. R. Westman. Shown also is a board of Sustaining Members of the A.E.S. Research Program credited to the Detroit Branch.

the annual Christmas Party was held the following day in the Statler Hotel with over 1,600 members and guests attending. An exceptional program was provided, headed up by *Howard McAleer*, program chairman.

John C. Drinkwater,
Publicity Chairman

Whitfield Chemical Apoints Butler

The appointment of *Joseph E. Butler* as a sales engineer for the *Whitfield Chemical Co.* has been announced by *C. Whitfield Smith*, company president. His territory will include parts of Michigan, Ohio and Indiana. Formerly, Butler was an industrial expediter with the Curtiss Wright Corp.

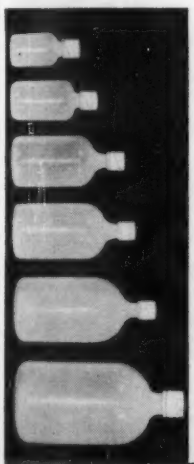
A native Detroiter, he attended Wayne University and Michigan State College.

Booth Joins Wyandotte

Richard C. Booth was recently appointed to the technical service staff of *Wyandotte Chemicals'* Pacific Coast plant. The announcement was made by *Donald E. Anderson*, director of technical service of the *J. B. Ford Division* of the Wyandotte, Mich., organization.

Mr. Booth graduated in chemistry from San Diego State College and during his three years with the U. S. Air Force as an armament and chemical officer, also studied at Yale. He has been employed as a paint chemist and as a process engineer by two well known California firms. In addition, Mr. Booth served the U. S. Naval Air Station and U. S. Naval Ordnance Test Station for five years. He is a member of the *American Chemical Society* and the Society of Aeronautical Materials and Process Engineers.

Pacific Coast users of cleaning and germicidal materials have available, through the Los Angeles laboratories



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Richard C. Booth

Kermit D. Collom

Stanley E. Jacke

where Mr. Booth will headquarter, the more than 50 years of recorded case histories on file with the department.

Detrex Appointments

Appointment of *Kermit D. Collom* and *Stanley E. Jacke* to the staff of the new Ultrasonics Division of the *Detrex Corporation* of Detroit, major manufacturer of industrial cleaning equipment and chemicals, has been announced by *William F. Newbery*, director of sales.

Collom will be in charge of sales, installation, and servicing of the new Detrex Soniclean machines which apply ultrasonic energy to precision metal cleaning. Jacke's duties will be devoted entirely to applied research in the ultrasonics field.

Prior to joining the company, Collom was employed by the Weltronic Corp. of Detroit for nine years doing applied research in induction and dielectric heating. For four years he performed non-destructive testing experiments in General Electric's Lockland, Ohio, laboratories. A graduate of the University of Wisconsin, Collom has degrees in chemical and electrical engineering.

Jacke, a graduate of Purdue University in electrical engineering, was on the research staff of the Delco-Remy Division of General Motors for three years.

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Fully stabilized—metal degreasing grade

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Continuous Supplies of Guaranteed Quality Meeting Most Rigid Requirements

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Udylite Names Sales Engineer

George W. Egger has been appointed a sales engineer of the *Udylite Corporation*, it was announced by *L. J. George*, Chicago district manager.

Egger has been assigned to the Chicago branch office and will serve the territory of Chicago, Aurora and Elgin, Ill.

He has a bachelor of chemical engineering degree from Ohio State University and formerly was with a chemical film and an insurance company. He served 2½ years with the U. S. Navy in the amphibious branch.

George W. Egger

Business Associates Honor W. J. Cluff

A group of business associates recently honored *W. Joseph Cluff*, president of *Frederic B. Stevens, Inc.*, (center), on his 70th birthday at a party in the Detroit Athletic Club. With him here are (left to right) *Walter E. Otto*, president of Michigan Mutual Liability Co.; *John D. Scofield, Udylite Corporation* lawyer and a director; *Arnold F. Malow*, president of Barton-Malow, construction company; and *Clyde H. Reeme*, president of Udylite.

A "This Is Your Life" transcription and slide film presentation traced Cluff's active business and civic career

3 REASONS FOR TIN PLATING YOUR PRODUCTS

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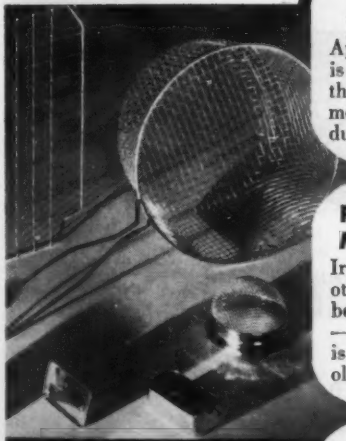

1 **USES LESS TIN than HOT DIPPING**

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Iron, steel, brass, copper and other metallic surfaces can be coated much more quickly —although equipment needed is simpler, less costly than older plating methods.

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Ample plating is assured even in deep and odd shaped locations. Deposit thickness and quality can be accurately and easily gaged.

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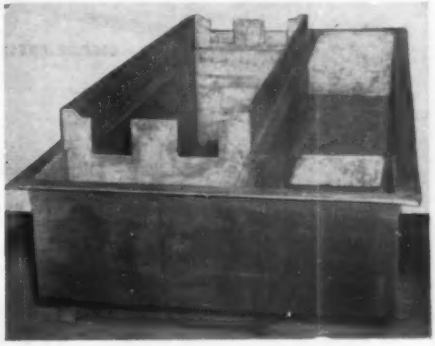

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STORTS has the technique for making lead linings that last — a lead welding specification that makes the weld the strongest, most resistant part of the lining. For longer service in your chrome plating tanks — and other lead lined jobs — let Storts do it.

STORTS WELDING COMPANY INCORPORATED

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Manufacturers of Welded Fabrications to Specification

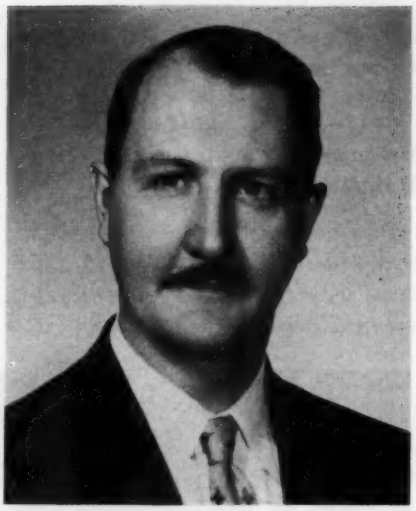
from birth on through his long association with the Stevens firm, now a subsidiary of Udylite. Cluff has been with Stevens for more than 50 years.

Marce Joins Wagner Brothers Sales Staff

Wagner Brothers, Inc., Detroit manufacturer of electroplating and metal polishing equipment and supplies, have announced the recent appointment of *Roger E. Marce* to their sales and service staff.

Mr. Marce will handle sales and service for the metropolitan Detroit district and has a widely diversified knowledge of metal surface preparation as a result of 18 years of experience in this field. Most recently, he was a sales engineer for the Grow Solvent Co., and technical director for the Neilson Chemical Co.

Marce is a graduate of the Lawrence Institute of Technology, with a degree in Chemical Engineering. Among numerous activities in the chemical field, he has served as Editor of the "Anachem News," a national publication about analytical chemistry, Chairman of the Association of Analytical Chemists and as National Councilor for the American Chemical Society.



Roger E. Marce

In addition to his professional interests, he has been director and vice-president of the Detroit Junior Board of Commerce and national president of his college social fraternity, Alpha Gamma Upsilon, for two consecutive years.

Michigan Chrome Appoints Kunish

Michigan Chrome & Chemical Co. of Detroit, Mich., announces the appointment of *Earl Kunish* to its sales territory embracing Missouri, Iowa, Southern Indiana and Southern Illinois. His activities will include sales and service work on the firm's complete line of rack coating and stop off materials for the electroplating industry as well as specialized vinyl plastisol coatings.

Earl Kunish

Prior to completing a several-month training program in the company's laboratory and plants, Kunish had

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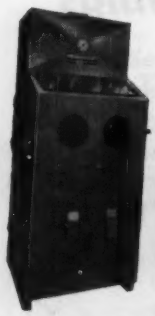
DEBURR DEEP HOLES
...NO STOCK REMOVAL



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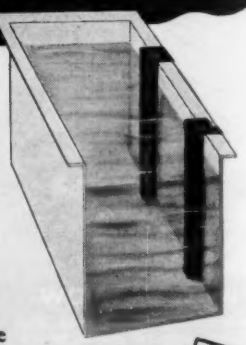
ELECTRIC RADIANT IMMERSION HEATERS

Heat by far Infra-Red. The scientific application of heat to all plating, pickling and phosphatizing solutions.



Features:

- Underwriter's Lab. approved junction box
- Midget fuses inside junction box
- Guard, holder, and junction box have Plasti Sol-type coating
- Renewable heating elements
- Use with automatic temperature controls

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WRITE FOR OUR 4-PAGE BULLETIN TL-52 . . .

Glo-QUARTZ ELECTRIC HEATERS CO., INC.
Mfgrs. of Fused Quartz Electrical Heating Elements
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considerable industrial experience as a process engineer at Shellar Engineering and Kaiser-Frazer. After wartime service with the Navy, he spent a number of years as traffic manager for Active Tool of Detroit. Kunish will headquarter in St. Louis, Missouri.

Stoddard Named by Detrex

A. W. Stoddard has been named director of public relations and advertising by the *Detrex Corporation* of Detroit, major manufacturer of industrial metal-cleaning equipment, chemicals, and dry-cleaning machinery. Stoddard formerly was director of advertising and assistant to the executive vice-president for the Syncro Corp. of Oxford, Mich., manufacturer of power tools and electronic equipment.

A. W. Stoddard

United Platers Promote Friedt

Glenn H. Friedt, Jr.

Glenn H. Friedt, Jr., has been promoted to vice-president and assistant general manager of *United Platers, Inc.*, it was announced recently.

Formerly assistant to the president, Friedt, at 29, becomes one of the youngest industrial executives in the Detroit area.

A native of Detroit, Friedt is a graduate of the University of Michigan and a member of the Michigan State Bar. He is president of the *Plating Institute of Michigan*, regional chairman of the *National Association of Metal Finishers*, and a member of the board of managers for the Detroit Branch of the *American Electroplaters' Society*.

United Platers is one of the largest job-plating and rust-proofing companies in the country. The 25-year-old company operates two plants in Detroit and lists all of the automotive companies among its customers.

ROBERT S. LEATHER DIES

As we go to press we are informed of the death of Robert S. Leather, founder of the Lea Mfg. Co., Waterbury, Conn., while on a Mediterranean cruise. An obituary will be published in our March issue.

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FILTER 50-1500 GAL/HR ANY ELECTROPLATING SOLUTION

NO ROUGH DEPOSITS
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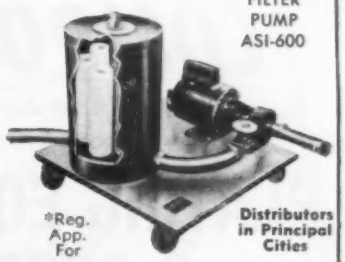
SETHCO FILTER PUMP ASI-600



SERVICE: Filters practically any acid or alkaline solution from pH 0 to pH 14; removes particles down to one micron in size. Strainer stops metallic objects.

DESIGN: Filter Assembly fabricated of stainless steel 316, high temperature lucite, rubberlined, Haveg, or Sethrin® resin. Filter Tubes of cotton, dynel, porous stone, or porous carbon. Pumps fabricated of Hastelloy, stainless 316, or plastic; centrifugal or self-priming. Motors drip-proof, totally enclosed, or explosion-proof, 110 or 220 volt, single or three-phase, 50 or 60 cycle, sleeve or ball bearing. Hose—special acid and alkali resistant. Base—Phenolic laminate on rubber tire ball bearing casters.

*Reg. App. For

Distributors in Principal Cities

Model	Rated Capacity	Overall Size	Weight
LSI-5	50 gal/hr	11" x 14" x 12"	30 lb.
LSI-10	100 "	12" x 16" x 16"	40 "
ASI-300	300 "	2' x 2' x 2'	125 "
ASI-400	400 "	2' x 2' x 2'	135 "
ASI-600	600 "	2' x 2' x 2'	150 "

*REG. APP. FOR

Sethco MFG. CO.

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74 Willoughby Street
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News from California

By Fred A. Herr

United States Spring & Bumper Co. of Los Angeles recently completed an expansion program in the plating and buffing departments of its plant at 4951 Alcoa Ave.

A new mechanical washer for cleaning automobile bumpers prior to plating has been installed just ahead of the chrome cleaner tanks. The washer is equipped with brass nozzles which direct cleaning solvents at high velocity on bumpers passing through. The firm's practice is to spray a water base emulsion solvent, which is heated and recirculated at the rate of 1100 gallons per minute.

Streamlining of finishing operations through installation of conveyor systems was also included in the program. The division in which the company's Silver Line farm product tools are finished is being conveyorized to expedite operation of the shop's twin tumbling barrels. The system is designed so that the silver painted parts, after being tumbled, will move by conveyor to the hand grinders, and then by overhead conveyor to an overhead paint dip tank, through a drip-off tunnel, and into the drying oven.

Installation was recently completed on a conveyor which moves bumpers from the nickel line to the straight-line automatic buffing machines. This section of the conveyor system is 240 feet long and accommodates 240 Oldsmobile bumpers.

James F. Carland, executive vice-president of the Chandeysson Electric Co., St. Louis, Mo., was a visitor in Los Angeles over the Christmas and New Year holidays. Combining business with pleasure, he visited various points of interest in Southern California with his daughter, and also held conferences with *A. D. Gaskin* and *Alfred E. Perkins* of the Alert Supply Co. in Los Angeles, West Coast distributors for Chandeysson generators.

Edward W. Wells joined the staff of Crown City Plating Co. in Pasadena, as a sales engineer, effective January 1. For the past 15½ years he had served in sales capacities in Southern California for the Chas. F. L'Hommedieu & Sons Co. Crown City Plating, of which *Harold Coombs* is owner and *Ray Bray* plating supervisor, operates the largest job shop in Pasadena. It specializes in production die cast and brass work.

Harry Duke, formerly active as a plater in the shop of Cadmium & Nickel Plating Co., Los Angeles, has been named to the sales staff of the Los Angeles Branch of Chas. F. L'Hommedieu & Sons Co.

Tool & Jig Plating Co., formerly at 1236 Rio Vista Ave., Los Angeles, has completed the move into new and larger plant facilities at 137 Baldwin Place, Whittier, Cal. Expanded machinery setups for chrome, copper and nickel plating, and buffing and polishing are available in the new plant, according to president *Ernest Fest*.

Diamond Finishing Co. has moved from 3055 East Twelfth Street to 1726

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Formulated Specifically To Meet Local Needs

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as a constant cleanser and purifier

It will:

1. Precipitate heavy metal impurities.
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Try a 5-gallon can, $15.00; or a 15-gallon drum, $42.75, on 30 days' approval.

Sulphur Products Co. Inc.

228 McKeon Way

Greensburg, Pa.

East Washington Boulevard, Los Angeles, where owner *Albert Dalton* has increased space and facilities at his command for automatic and phosphate treating of metal parts.

Cannon Electric Co. has opened a third plant in the northside district of Los Angeles at 210 West Ave. 26, adjacent to its main factory at 3209 Humboldt St. The new building, which covers 6,000 square feet, was erected to serve the needs of expanded production of hermetically sealed electric connectors. Administration, engineering, final assembly and shipping facilities of the Hermetic-sealed steel connector division are housed in the new building.

Production was due to begin within the next several weeks at the new paint products plant of Gelvatex Corp. at 901 East Vermont Ave., Anaheim, Cal. Construction work on the 2-story half million dollar plant began in midsummer of 1953. It is equipped with the latest designs of mixing machines, blending vats and stainless steel pumps and piping in which the vinyl acetate resins incorporated in the company's coating product will be compounded.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Full Schedule Planned for Ladies Attending 1954 Convention

For the first time in seventeen years, the New York Branch will play host to the American Electroplaters' Society at their annual convention to be held July 12 through July 15, 1954 at the Hotel Statler, New York City.

The Ladies' Committee has prepared what promises to be a most full and entertaining week for the women attending the convention.

On Sunday, July 11, the "get-together" party has been scheduled for the early registrants. An outstanding film on New York City by *Terry Manos*, entitled *"The Twenty-Four Dollar Purchase,"* will be shown. Refreshments will be served following the film.

Monday morning will bring the official opening to the convention and will feature talks by outstanding personalities. A tea party will be given on Monday afternoon, the feature of the tea being a talk of great interest to the ladies. Monday night will feature the Fellowship Open House with one of the leading orchestras of the country and food galore. As always, this party will be sponsored by the *Metal Finishing Suppliers' Association.*

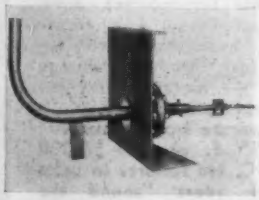
On Tuesday, July 13, *Oakite Products* will once again sponsor the "Aunt Ella" luncheon, which is always one of the annual highlights of the convention. It will be held at the famous Tavern on the Green, and will feature *Dave Clarin* as *Aunt Ella.* In the evening, the *Udylite Corporation* will sponsor an evening's entertainment at one of the leading Broadway plays.

Wednesday, July 14, will be "Outing Day." A pleasant sail up the Hudson to Bear Mountain has been plan-

KNAPP MILLS ANNOUNCES Three New Developments

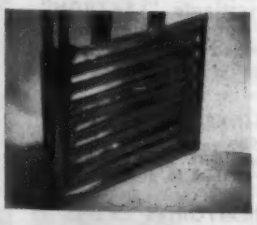
*FERROLUM ANODES

1. Permanently Rigid — Excellent Conductivity — Lighter in Weight — Long Life — Economical.



2. *FERROLUM GAS HEATER

Low fuel cost, simple to operate, direct fired. Efficient, compact, economical, simple to operate and install. Sturdy, excellent corrosion resistance.



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High efficiency, low steam pressure. Large heating surface — Economical and efficient.

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Tin—Plating Residues
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Write indicating grade and quantity available

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Prompt reply... favorable market prices

Metallurgical
ESTABLISHED 1909
PRODUCTS COMPANY
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Seated, left to right: Yolande Fusco; Margaret MacStoker and Millie Cates (Advisory); Barbara Schore (Chairman); Edith Goldwasser and Betty Cinnamon. Standing, left to right: Mildred Hartshorn; Winnie Herrmann; Ethel Braun (Advisory); Rose Schneidt and Bess Nadel.

ned with the following activities: luncheon, the East-West ball game, swimming, boating, etc. The complete day will be under the sponsorship of the *Frederick Gumm Chemical Company*. This outing is for all men and women registered at the convention.

Thursday will bring visits to the U.N. or Radio City, both of which are sponsored by the *Bart-Messing* and *Sel-Rex Corporations*. Also on Thursday, *Joan Wiarda* will act as hostess at the annual "Plato Party." Gifts and prizes will be given at the party. The Grand Banquet will be held Thursday evening, featuring an excellent meal, an all-star Broadway review and dancing.

Souvenirs and gifts will be given during the convention. One which has already been pledged by the *Rapid Electric Company*, an orchid to each lady, will be given the night of the final banquet. Cocktail parties will be given throughout the convention.

There will be time to visit, shop and see the sights. A committee has been appointed to fulfill your every wish. The committee will be looking for you July 12 to July 15, 1954 — plan to attend.

Ladies Committee: Mrs. Barbara Schore — Chairman. Advisory — Mrs. Ethel Braun, Mrs. Molly Cates, Mrs. Margaret MacStoker.

Mrs. Rose Cinamon, Mrs. Tillie Cooperman, Mrs. Yolande Fusco, Mrs. Edith Goldwasser, Mrs. Mildred Hartshorn, Mrs. Winnie Herrmann, Mrs. Bessie Nadel, Mrs. Rose Schmidt.

Jackson-Lansing Branch

The current monthly meeting of the Jackson-Lansing Branch was held December 8 at the Hotel Porter, Lansing, Mich.

An outstanding meeting was held after an excellent roast beef dinner. We were very fortunate in obtaining for the evening, *Jack Van Coevering*, Wildlife Editor for the Detroit Free Press. Mr. Van Coevering has travelled extensively over the entire United

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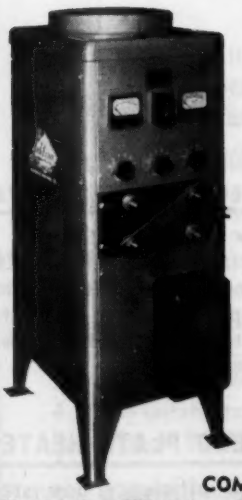

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States, and is a prominent authority on Michigan Wildlife conditions.

A mighty interesting talk was given, followed by a colored movie covering Winter scenes both sports and hunting, also spring, summer, and fall activities, many striking scenes were shown. Crow shots were of interest with bow and arrow action and excellent showing of champion dogs.

Mr. Van Coevering is nationally known for his work in conservation and wildlife and his achievements.

A short business meeting followed the program.

R. W. Redmond

Indianapolis Branch

The Indianapolis Branch proposes to nominate one of its past presidents, *Tom Evans* for the office of 3rd vice-president of the society at its next National Convention July 15th at New York City.

Mr. Evans is 51 years of age. He has been in the plating business for 26 years. During the past 14 years he has owned and operated "Plating Service" at Columbus, Indiana, specializing in hard chrome.

Tom is a large man and as all large

Tom Evans

men he has a friendly and jovial personality. Makes friends easily and is quite capable of administrating the affairs of the A.E.S. Being in business for himself, Tom will be at liberty to travel in the interest of the A.E.S. as the needs require.

New York Branch

Held December 11, 1953 at the Hotel Statler, the meeting of the New York Branch was called to order by *A. Amatore*, president. The minutes of the last meeting were read and approved. The roll of officers was called and D. Hartshorn was noted absent.

President Amatore had the pleasure of announcing the following visitors:

A. Korbelak, editor of Plating; *R. Ehrhardt, G. Butrich, Louis Donroe* and *Dr. D. G. Foulke* from Newark Branch.

President Amatore also announced the presence of *M. Fannon*, one of our old timers, who, for some time, has been on the absentee list, due to ill health, but is now back in fine shape.

The following men were elected to membership and duly installed:

R. Ippolito, F. Gallaway, H. Porisi, H. C. Schneider, S. Maynard, H. Kashman.

There being no other business, the meeting was turned over to *P. Veit*, librarian, who, in turn, presented Mr. Donroe.

Mr. Donroe's subject was "Questions and their Answers." on the various plating baths, solutions and their make up, which was most interesting.

Lester Levinson,
Recording Secretary

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Dayton Branch

The Dayton Branch will hold its Ninth Annual Educational Session and Dinner-Dance on Saturday, February 27, 1954 at the Dayton Biltmore Hotel.

Three outstanding papers will be given at the Educational Session starting at 1:30 P.M. *William Neill*, past president of the Supreme Society, will serve as honorary chairman. The speakers and their topics are:

A. R. Burman, Cro-Plate Co., Inc., Hartford, Conn. Subject: Pressure Wet Blasting.

R. O. Hull, R. O. Hull & Co., Inc., Rocky River, Ohio. Subject: To be announced.

J. C. Harris, Ass't. Director of Research of the Central Research Dept. of Monsanto Chemical Corp. Subject: Tests for the Determination of Metal Cleanliness.

The Dinner-Dance in the main ballroom of the Dayton Biltmore will start at 7:00 P.M. Tickets are available at $6.50 per plate. For tickets and reservations contact *R. L. Ruleff*, 705 Hollendale Dr., Dayton 9, Ohio.

John K. Easton,
Secretary

Chicago Branch

About 50 Chicago Branch members turned out on December 11th, to hear *Dr. F .E. Van Atta*, Director of Industrial Hygiene, *National Safety Council*, discuss safety in the plating room. As is usual at Chicago Branch the business meeting and cocktail "mixer" preceded the dinner, and educational session.

At the business meeting, after reports from the chairmen of the various active committees, a letter from the national office of Plating Magazine requesting back issues of the magazine was read. Among the desired issues are August 1923, July 1926, and May 1928.

Also heard at the business meeting was good news for prospective new members. A great deal of thought is now being given to a plan for a sponsor method of getting new members acquainted in the branch. The new method will also make participation in branch activities easier and more interesting for new members.

Unfortunately, Dr. Van Atta's plane was late and he was unable to have dinner with the assembled members. In fact, he arrived at the "eleventh hour" just as the group were getting ready to start a general discussion of plating and plating problems as a substitute for his talk. However, his talk was well worth waiting for. Dr. Van Atta's interest in and his intimate knowledge of his field, made for an extremely interesting and informative presentation.

Since his primary interest is the public health aspects of plating room hazards, his talk concerned itself primarily with the effects of finishing operations on the health of those either performing them or performing near them.

Both buffing and polishing, he pointed out, are inherently hazardous to health because of the amounts of various dusts produced, however, the hazard, can be eliminated by the use of well designed ventilating and dust collecting equipment.

Cleaning and degreasing do not present many health problems unless shop ventilation is extremely poor. Degreasing too creates few problems except where equipment is either poorly designed or located.

With direct reference to plating, Dr. Van Atta told the group that chro-

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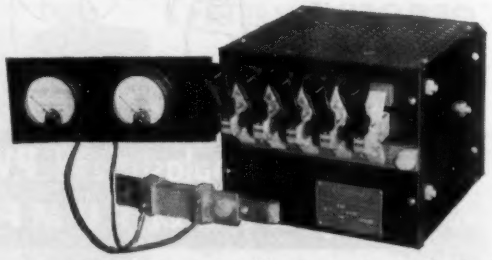

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mium plating presents by far the greatest health hazard. In spite of this, adequate ventilation and proper use of protective clothing can combine to reduce this hazard to a minimum.

In addition to his remarks on respiratory hazards, Dr. Van Atta discussed some forms of dermatitis likely to occur around the plating room. For example; nickel itch. Generally most of these conditions can be readily controlled by avoiding all contact with the irritating solution. After his talk Dr. Van Atta discussed many specific questions put to him from the floor.

Last, but certainly far from least, the Chicago Branch cordially welcomed the following new members to the Branch: *Joseph J. Schaeffer* of Udylite, *Albert Benjamin* of Clinton Supply, and *James J. Perry* and *E. D. Fontaine* of Mitchell De-Burring.

Jerome Kudema

Cincinnati Branch

The meeting on December 16, 1953 was called to order by acting president, *William D. Gordon* with twenty-nine members and guests present. The minutes of the October and November meetings were read by the secretary. These minutes were approved as read.

W. Loveless as Chairman of Tri-State Educational Session and Dinner Dance gave a report on the progress of the committee to date and asked for the cooperation of the Society as a whole. January 7, 1954 was set as the next meeting date of the committee and the Tri-State Annual affair.

Mr. Gordon introduced *John A. Swift* of the Swift Industrial Chemical Co., Canton, Conn., who gave a very entertaining and informative talk on the manufacture of steel and what factors affect plating. His talk included the composition of steel, methods of making steel, general terms applied to steel, methods of specifying steel and lubricants used in rolling of steel. His talk was augmented by slides and followed by an interesting question session.

The meeting adjourned at 10:00 P.M. and everyone retired to the dining room to enjoy a social hour the courtesy of *Products Finishing*.

William Young,
Secretary Cincinnati Branch

Baltimore-Washington Branch

On Tuesday, December 8, 1953, at 8:00 P.M., the Baltimore-Washington Branch held a meeting at the National Bureau of Standards, Washington, D. C.

This meeting consisted of a very short order of business followed by a very informative talk about the Kanigen process by *Richard W. Landon*. Mr. Landon displayed samples to show how this process could be used to do a better job under certain conditions than that normally accomplished by electroplating.

New England Branches

The New England Regional Conference of *The American Electroplaters' Society*, which consists of the Hartford and New Haven Branches, will hold its fifteenth annual Educational Session and Banquet at the Hotel Bond, Hartford, Conn., on Saturday, May 15, 1954. The educational program will be held in the afternoon, followed by the banquet in the evening.

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New York Branch

The November 13th 1953 meeting at the Hotel Statler was called to order by *A. Amatore*, president.

Roll of officers was called and the following were noted absent: *Mssrs. Schore, Nadel, Herrmann, Maher* and *Veit.*

Mr. Amatore announced that a committee from the New York Branch had visited *J. Sterling* and found him in very poor condition.

The following men elected to membership and duly installed: *G. Herring, A. Ehrensberg, R. Della Rotta, W. Tilles, A. Johnson, A. Kaye, I. Feldman, F. Gill, P. Parmenter, S. Missewcz* and *V. Court.*

There being no old or new business the meeting was turned over to *D. Hartshorn*, acting as librarian in the absence of Mr. Veit, who, in turn, presented *John F. O'Brien*, of Joseph F. Kern, Jr. and Assoc. Inc.

Mr. O'Brien's talk was on "Air Pollution and Dust Collectors," which was most interesting.

Bridgeport Branch News

On December 12, 1953 in the famous "Winter Quarters" of the Hotel Barnum the Bridgeport Branch A.E.S. held their traditional Christmas Dinner Dance. More than one hundred members and guests including many from sister branches were in attendance. The ball was started rolling by the serving of an excellent dinner featuring roast Vermont turkey with all the trimmings. Needless to say, the "cup that cheers" was prominent on all the tables.

The melodic strains of Bob Wellers five orchestra serenaded the party during the dinner and later provided the inspiration for "The Bunny Hop" and for individual attempts at the art of walking the floor. One of the highlights of the evening was a visit from Santa Claus and his helpers. Santa supervised the distribution of the gifts to the deserving "children" present. Door prizes donated by various members of the selling fraternity and employers of members were most enthusiastically received. The New York type floor show was met with enthusia-tic approval and was augmented by the heretofore undisclosed talents of *Larry Bennett.* The great majority of guests voiced their delight and claim that Larry is ready for big time. At 1 o'clock to the tune of "Home Sweet Home" the happy guests started to trek homewards.

Robert Parker,
Sec. Treas.

M.F.S.A.

The trustees of the *Metal Finishing Suppliers' Association, Inc.* held a special board meeting on the afternoon of December 19th, in the Robert Treat Hotel in Newark, N. J. The meeting was well attended and of longer duration than usual.

While the chief purpose of the meeting was a year-end appraisal of the activities of the corporation during 1953, much time was devoted to plans for 1954, with particular consideration being given to the part that the M.F.S.A. will play in the coming A.E.S. Convention in New York City this

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summer. A number of committees of the two organizations are already collaborating in an effort to make this affair a memorable and most successful one.

Although it may seem premature to some, the meeting also heard a report on the hotel situation in Cleveland where the 1955 Annual Convention is scheduled to be held, and *T. A. Trumbour* of the Open House Committee was authorized to take such steps as appeared desirable to make proper arrangements to accommodate the functions of the M.F.S.A. there at that time.

The treasurer reported the corporation to be financially in the soundest position in its 30-year history and, before the meeting adjourned, the trustees listened to a proposal from *R. M. Shock* of N.A.M.F., Inc., advocating closer cooperation between all the organizations in our industry toward their common advantage.

THE ELECTROCHEMICAL SOCIETY, INC.

Future Meetings of the Society

May 2-6, 1954, La Salle Hotel, Chicago, Ill. Sessions on Electric Insulation, Electronics, Electro-Organic Chemistry, Industrial Electrolytic, and Theoretical Electrochemistry.

October 3-7, 1954, Statler Hotel, Boston, Mass. Sessions to be announced at a later date.

May 2-5, 1955, Sheraton-Gibson Hotel, Cincinnati, Ohio. Sessions to be announced at later date.

October 9-13, 1955, William Penn Hotel, Pittsburgh, Pa. Sessions to be announced at a later date.

National Metal Show

The 36th National Metal Exposition and Congress, sponsored by the *American Society for Metals*, will be held in Chicago, at the International Amphitheatre, November 1-5, 1954. Copies of the floor plan are now available to anyone interested in exhibiting at the show. The Space Assignment Committee, which will meet on or about February 17, 1954, urges that reservations be in early in order to avoid disappointment later on.

For further information contact the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

N. A. C. E.

For the third year an award of $50. and a commendation will be given to the author whose paper published during 1954 in *Corrosion* is judged to be the best of those by authors under 35 years of age. Corrosion is the official monthly publication of the *National Association of Corrosion Engineers.*

The award, funds for which are supplied by an anonymous donor, will be divided when a paper with multiple qualified authors is judged best. The decision on the best paper is made by a committee named by the president of N.A.C.E.

Further information and a copy of the association's "Guide for the Preparation and Presentation of Papers" may be obtained on request from A. B. Campbell, Executive Secretary, National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas.

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sections of the *National Association of Corrosion Engineers* at Montreal and Edmonton, Canada and at Miami, Fla., have been received and have been approved. Organization of the sections is now under way by interim officers. The new sections will bring the number organized in N.A.C.E. to 38.

OBITUARIES

GEORGE B. HOGABOOM

George B. Hogaboom, one of the world's foremost authorities on electroplating and finishing, died December 31, 1953 in New Britain General Hospital at the age of 79. Funeral services were held on Saturday, January 2, 1954 at South Congregational Church, of which he was a member, and burial was in Fairview Cemetary. He is survived by his wife, Mrs. Emma Hogaboom; a daughter, Mrs. Charles N. Crockett of Manchester, Conn.; two sons, Ovide of Newington, Conn. and G. Byron Hogaboom of Kenilworth, N. J.; and five grandchildren.

Born June 26, 1874 in Brooklyn, N. Y., Mr. Hogaboom was a direct descendant of early Dutch settlers and began his career at the age of 14 in a New York City metal novelty plant, where he first learned about plating silver and gold. While attending night classes in electroplating at Newark Technical School in 1903, he was offered a position as superintendent by James M. Morehouse the instructor who also conducted the largest job plating shop in Newark, N. J. In July 1905 he became associated with Archibald Klement Co., pioneers in silverdeposit ware, in which position he was responsible for most of the improvements in the process and developed what is generally considered the first example of analytical control of a plating solution, permitting him to increase plating speed tremendously and to improve the quality of the thick silver deposits. His salary was $25 per week, considered high at that time.

He resumed his studies in chemistry at Newark Technical School, which had been interrupted, graduating in 1910 as president of his class, and was immediately appointed instructor in electroplating to replace Mr. Morehouse, who had resigned. He taught the evening course for three years, including among his students V. W. Todd, Ed Boice and Oliver Sizelove, and two evenings each week he studied under Thomas A. Edison at the inventor's laboratory in Orange, N. J. Mr. Edison offered him a position in his storage battery plant but plating was in Mr. Hogaboom's blood and he declined the offer.

Anticipating a decline in the popularity of silverdeposit ware, he accepted the position of foreman plater at the P. & F. Corbin division of the American Hardware Corp. in New Britain, Conn. in Sept. 1913 but, in the meantime, assisted in the founding of the *Electroplaters' Society* in 1909, acting as its first librarian. This led to the secretaryship of the *National Electroplaters Assn.*, in the course of which office, his correspondence quadrupled the membership. He edited the *Quarterly Review* of the Association, later the *Monthly Review* for more than three years until, in Feb. 1913, the members met in New York and organized the *American Electroplaters' Society* so that branch organizations could be established in different cities. Mr. Hogaboom became the first president of the Society.

In Oct. 1915 he entered the employ of the International Silver Co. to take charge of the flatware plating department but left in Sept. 1917 to become director of research of Scovill Mfg. Co. in Waterbury, Conn. where his duties included supervision over production of all the buffing compositions, soaps, lacquers and other materials employed. Borrowed by the War Department for the duration of World War I, Mr. Hogaboom was stationed at the National Bureau of Standards in Washington, D. C., from which base he travelled all over the nation advising manufacturers on metal finishing problems. It was at the Bureau that he first worked with Dr. William Blum and began a collaboration which resulted in the writing of their classic textbook "Principles of Electroplating and Electroforming," now in its third edition.

Returning to Scovill after the war, Mr. Hogaboom developed the practical use of rolled nickel anodes and was first to employ straight single nickel salt solutions on a large scale. For about two months in 1921 he became associated with Bennett & Seeley, distributors of plating supplies, during

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which period Scovill paid him the unusual compliment of leaving his desk and papers untouched so that, upon his return, he would be able to take up exactly where he had left off. In the fall of 1923 he was requested to return to P. & F. Corbin where, for 19 months, he directed the operations of five separate departments, which previously had each required a separate foreman. Since the requirements of his position did not permit him sufficient time to attend technical meetings and to advance his knowledge of plating, he resigned in Feb. 1925 to accept a position as electroplating engineer with Hanson Van Winkle Co. of Newark, N. J. where, with the cooperation of The International Nickel Co., he commercialized rolled nickel as an anode material and developed the carbon-free anode which later became the "depolarized" anode.

This company became Hanson-Van Winkle-Munning Co. and set up operations at Matawan, N. J. while Mr. Hogaboom served as director of research until World War II, when he was again borrowed by the government to act as technical advisor in the War Production Board. After the war's end, he returned to New Britain, where he had maintained his residence over a period of 40 years and, having received a state license as Professional Engineer some time previously, he practiced as a consulting engineer until the time of his death.

Among Mr. Hogaboom's developments were the special cloth for buffing wheels known as "balanced" sheeting, a bright cadmium solution, an electrolytic descaling process, and the zinc anode containing aluminum and mercury, a total of about 15 patents. He was the first to employ an electric furnace to melt nickel for anodes and perfected the manufacture of centrifugal cast nickel anodes. A frequent contributor to the technical literature, he was a former associate editor of *The Metal Industry*, now METAL FINISHING and has left a heritage of innumerable articles on plating and other finishing subjects. His host of friends will mourn the passing of one of the truly great pioneers.

IRVING BERKMAN

Irving Berkman, one of the most prominent members of the New York job platers group, died at Montefiore Hospital in New York City on December 10, 1953, after a long illness. He was 48 at the time of his death.

A native and resident of New York City, Mr. Berkman was graduated from Stuyvesant High School. As a young man he learned the plating business by working in various departments of several metropolitan contract plating shops, while educating himself in the arts and sciences. In 1930, with his brother Herman as a partner, he organized the job-plating firm of Berkman Bros., Brooklyn, N. Y.

In 1935, Mr. Berkman joined the Masters' Electro-Plating Association of New York City and, in a short time, because of his intense interest in the welfare of the plating industry and his sincere devotion to the Association, was elected to the executive committee. He served on the committee variously as chairman, vice-chairman and, at the time of his passing, was acting as treasurer. On October 27th of last year he was awarded the "Plating's Man of the Year" honor.

Services were held at Park West Chapel with Masonic rites on December 11th and burial was in Wellwood Cemetery. He is survived by his widow, a son and daughter, six brothers and a sister.

ALFRED PRITCHARD

Alfred Pritchard, who was well known in the plating field, passed away recently. He had been in the industry for 60 years.

Mr. Pritchard is survived by his widow, son and two granddaughters.

HOWARD E. CHRISTIE

Howard Emerson Christie, 62, founder and owner of a large electroplating concern, died at his home Jan. 3, 1954 after a long illness. He established the Christie Plating Co., Inc., in 1931, and managed it until ill health forced his retirement a year ago.

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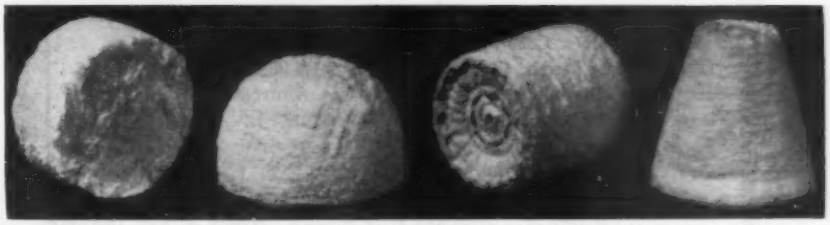

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